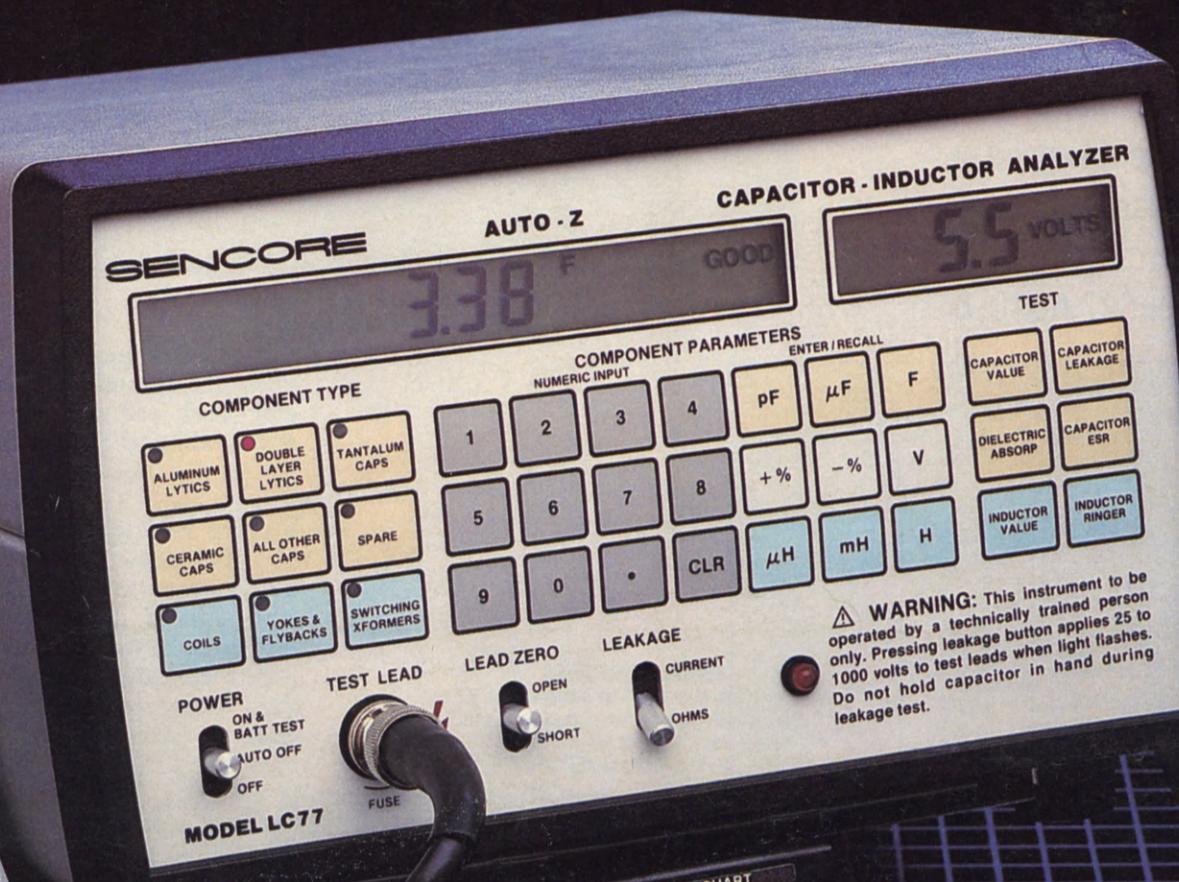


# SENCORE NEWS

All American designed, produced, sold and serviced.

Issue #134 Oct./Nov. 1987



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**Learn How Functional Analyzing Solves Video Troubles 54% Faster; page 8**

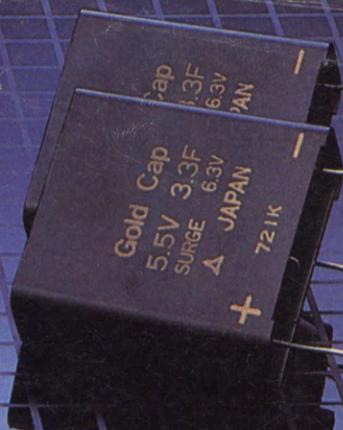
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# Introducing The LC77 AUTO-Z

For the first time in the history of electronics, with the information that's provided on the component itself, you can determine whether a device is good or bad. Simply enter the information from the component into the LC77, and "The Z Standard" automatically tells you if that component is good or bad based on EIA and industry standards. There are no calculation or interpretation errors! You truly have to see the award winning LC77 AUTO-Z to believe it!



It's like having your own Standards Engineer with you at all times.

## Capacitor & Inductor Characteristics

Measure capacitor value, leakage, dielectric absorption and ESR as well as inductor value and patented ringing test.

## GOOD/BAD Test

Eliminates guesswork as it automatically compares the parameters of the component under test to internal EIA and industry standards tables.

## DC Voltage

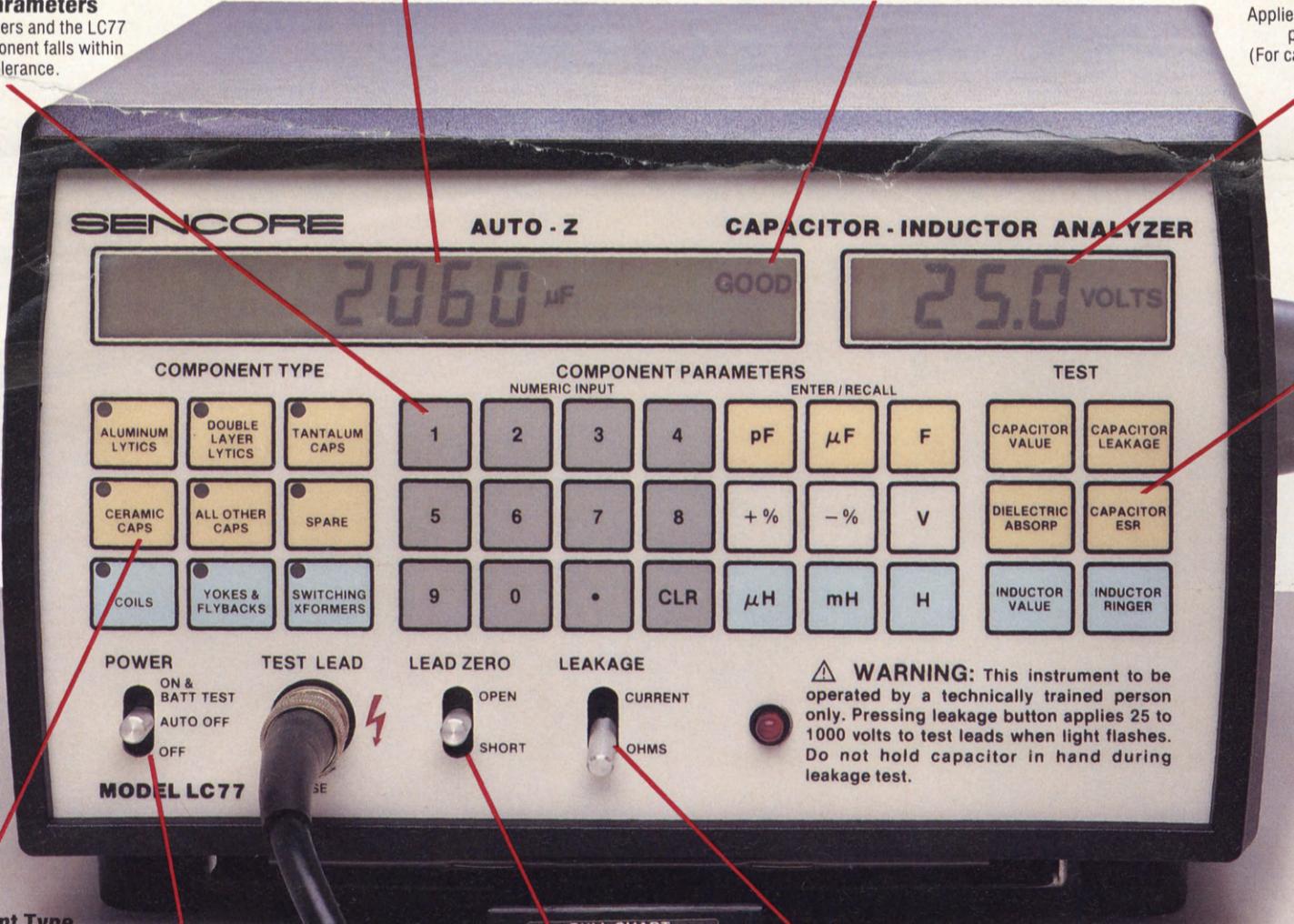
Applies DC from 1 volt to 1000 volts in programmable 0.1 V steps.  
(For capacitor leakage & hi-pot tests.)

## Capacitor And Inductor Tests

Delivers all the market proven Z Meter tests at the push of a button.

## Component Parameters

Enter the parameters and the LC77 tells if the component falls within standard tolerance.



**\$1,895**

Triple Patented  
On GSA Contract

## Component Type

Enter capacitor or inductor type (the LC77 references internal EIA tables according to component type).

## Portable, Battery Operated

Provides 9 hours of capacitor and inductor testing in the field or in the factory.

**Automatic Lead Zero**  
Removes stray lead inductance, capacitance, and resistance, and assures accurate readings.

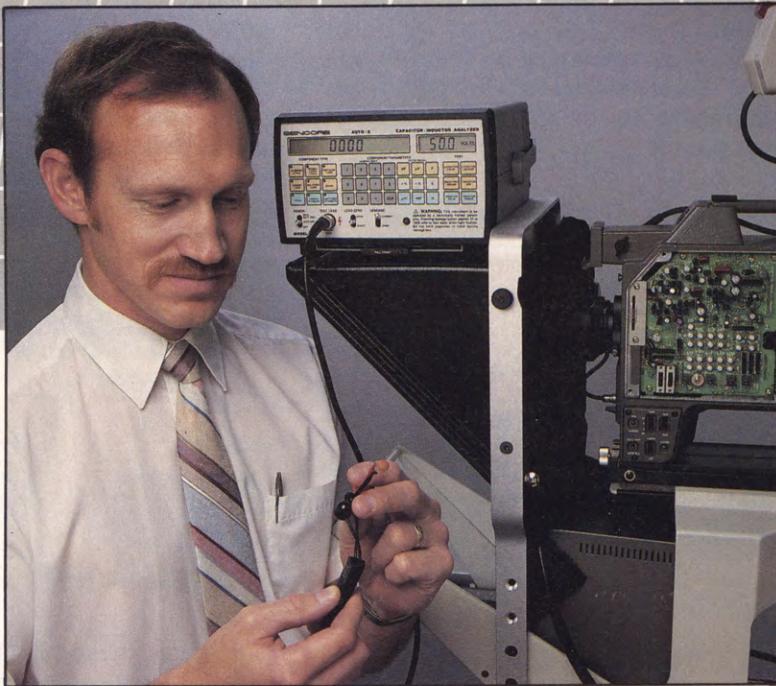
3/4 ACTUAL SIZE

**Leakage In Current Or Ohms**  
Tests capacitor leakage up to 1000 volts DC applied or insulation leakage (Hi-Pot Tester) to 1,000,000,000 ohms.

IEEE 488  
BUS-COMPATIBLE

# NEW

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## Customer Questions Spur Engineering Break-Through In First Ever, Automatic, Error Free, Dynamic, Cap/Coil Analyzer—Learn How The New LC77 AUTO-Z Answers The Challenge...

by Tom Schulte, Application Engineer

cap/coil analyzer in the history of electronics service. Its successor, the triple patented LC75 Z METER 2 (1986) is solving component

testing problems for thousands of servicers each day. So, why did we build the triple patented (and patents applied for) LC77 AUTO-Z?

Successful Z Meter users, quick to recognize increased profits and time savings, asked us to build a meter that completely eliminates wasted time, calculations, and measurement interpretations. They asked if we could build a meter that automatically tests the component and makes the decision, good or bad, without calculation, look-ups, interpretation or error. These successful servicers knew the value of a troubleshooting meter that would stop, once and for all, the common user errors that sneak in during manual testing.

Let's take a look at the important capacitor and inductor troubleshooting tests to see why servicers are asking for help.

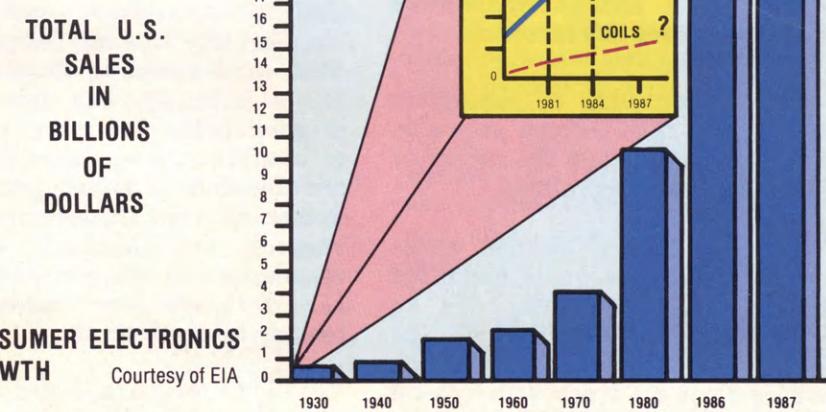


Fig. 1: The 1984 RCA CTC131 chassis contains 665 capacitors and 136 coils compared to the 1981 CTC108 chassis with only 263 capacitors and 57 coils.

The Electronics Industry could be leaving successful shops in the dust; it's growing by leaps and bounds - both in size and sophistication.

It's time to catch up with today's fast developments, especially in capacitor and inductor testing. No longer can these troublesome components be overlooked. Cap and coil troubles have always been there, but did you know that today they account for 42% of your troubleshooting time?

According to EIA Service Profiles, there are 114 million TVs and 40 million VCRs in use today! Since 1976, capacitor, coil and transformer sales have topped 19.6 billion dollars in the United States alone. These caps and coils are now a part of the whopping big increase you've seen in electronics products, the products you work on every day!

Integrated circuit bypass, filtering, and coupling capacitor use has increased by three to five times over the number used just 5 years ago. Coil use has also increased in video, IF, and RF stages.

Today, many capacitors and inductors are smaller in value and have tighter tolerances. Plus, capacitors larger than 4 Farads and coils as high as 10 Henrys are showing up in consumer products. Isolating troubles down to the component is getting tougher to do. Busy troubleshooters need a Cap/Coil tester that covers a wide range of components, and tests them without interpretation, calculation, look-ups, or error! There's only one tester built that can do that, it's the new Sencore LC77 AUTO-Z automatic microprocessor controlled capacitor and inductor analyzer.

### Customers Who Have Seen The New LC77 AUTO-Z At Seminars And Workshops

### Across The USA And Canada Are Very Excited About Its Superior Performance.

"You can hardly believe the miracle breakthrough that it is, until you see and use the AUTO-Z."

For 1987, the most asked about Sencore instrument is the triple patented, LC77 AUTO-Z (winner of the coveted 1987 ABEX award for business excellence). And, every question we've received, in one way or another, is answered with this exclusive Sencore promise: "The AUTO-Z, over any other instrument, increases your profit (and thus success) in LCR component troubleshooting, guaranteed." This is a very bold promise, let's see why it is true.

### 1. Why Build Another Z Meter?

The original, patented, LC53 Z Meter (1979), was the first dynamic



Fig. 2: The most asked about Sencore instrument is the triple patented LC77 AUTO-Z, winner of the award for business excellence (ABEX).

make a decision? Can you make these calculations every time without error?

Do this exercise in your head (or is a calculator handy?):

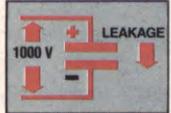
**One:** Multiply the .033 uFd cap's value by the tolerance to find the allowed variation.

**Two:** Add the variation to, and subtract it from, the cap value to find the upper and lower value limits.

**Three:** Move the decimal (on your value tester's reading) three places to the left, to change from nanofarads to microfarads.

Do you have the answer yet? Is the cap good or bad? How long did it take for you to decide? Only a minute or two? Does that include when you checked the capacitor's value again to be sure it was within the good/bad limits you've figured?

Each wasted minute costs you 50 cents of profit (based on a labor rate of only \$30/hour).



### Leakage

A true, dynamic leakage test requires that you check the capacitor's leakage at its full rated voltage. But, there are a few things to be aware of when testing for leakage:

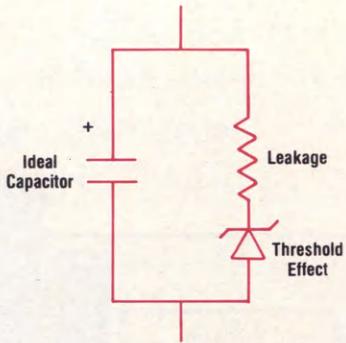
**One:** An advantage of the leakage test is that you can reform many bad electrolytics. The important thing to remember about reformed electrolytics, however, is performance. If you have to reform it every time you test it, waiting a long time for leakage to show good, then the capacitor can't work properly in the circuit.



**Fig. 3:** After testing thousands of capacitors, Sencore Engineers have proven that capacitors show leakage problems more reliably when tested at their full rated voltage.

can remember from basic electronics: Time = Resistance X Capacitance or  $T=RC$ . The capacitor should be fully charged in about five time constants (10 seconds for a 100,000 uF electrolytic tested on the Z Meter) and at that time, leakage current should be near zero. An automatic test that determines whether the capacitor is "good" or "bad" by testing its value and tolerances against EIA and industry standards takes the guesswork out of this critical capacitor test.

**Two:** Unless your test voltage goes to 1,000 VDC, you may overlook bad capacitors that break down at the circuit voltage, but not at lower voltages.



**Fig. 4:** The Z METER leakage test supplies enough voltage to overcome the threshold, which acts like a zener diode in series with the leakage. Low voltage ohmmeters cannot overcome this threshold.

Tests of thousands of capacitors have proven that leakage problems often show only when the capacitor is tested at its rated voltage.

**Three:** The allowed leakage varies with capacitor type, value, and rated voltage. So, unless you have an automatic test that uses all the known industry standard specifications, you are stuck with look-up tables, interpretation, and errors.

### Dielectric Absorption (D/A)

In talking to professional servicers at Sencore Workshops and seminars, we have found that this little-understood capacitor trait (D/A) is found to be the culprit in many of their "tough dog" troubleshooting problems (See Tech Tips 101 and 105 on return card).



**Fig. 5:** Dielectric absorption prevents a capacitor from fully discharging because it acts like a small battery is inside.

How long do you let the leakage test run? If you wait until every capacitor passes, you'll be at your bench for hours re-forming electrolytics. The answer? Charging time for a good capacitor depends on the value of the capacitor and the resistance of the charging path. You

Dielectric absorption prevents a capacitor from completely discharging. Capacitors which store a DC voltage to control other circuits must have extremely low levels of D/A. All capacitors have some dielectric absorption, but it takes attention to detail to measure it accurately.

Type	Percentage
Aluminum Lytic	15%
Double Layer	15%
Tantalum Caps	15%
Ceramic Caps	10%
All Other Caps	1%

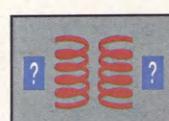
**Fig. 6A:** The good/bad limits for dielectric absorption programmed into the LC77 AUTO-Z.

Use	Practical Limits
Timing	1%
Sample Hold	1%
Audio Coupling	5%-15%
Power Supply	15%

**Fig. 6B:** The actual D/A limits depend on the circuit using the capacitor.

You should always toss any capacitor that shows 15% or more dielectric absorption. And, critical circuits like timing, sample and hold, and coupling require capacitors with D/A as low as 1% (Figure 6). The problem is, you have to interpret the readings and make the decision — unless you use an automatic test that compares the suspect cap against industry standards and tells you whether the cap is "good" or "bad" without look-up tables or error.

size shrank and its value skyrocketed that ESR was identified as a leading cause of failure. And, wouldn't you know? All capacitors have some ESR—and the amount that allows good performance in any circuit varies with capacitor type, value, and rated voltage. Only a tester that has all the known EIA and industry standards programmed in can easily test every electrolytic capacitor for ESR. And only the triple patented LC77 AUTO-Z does that automatically without calculation, interpretation, look up tables or error.



### Inductor Value

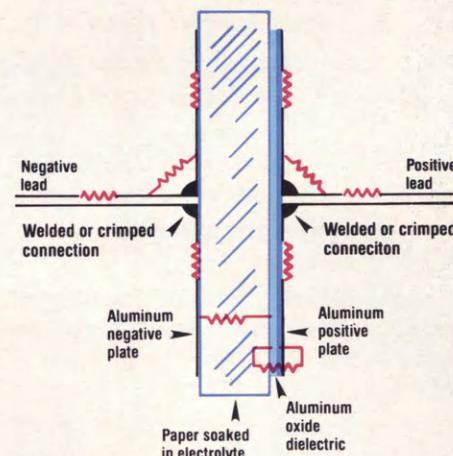
Coil testing is similar in many ways to capacitor testing. The inductance value is critical to proper circuit operation in amplifiers, oscillators, and filters. And, you have to know the kind of coil, its value, and its tolerance. A hi-Q coil with a shorted turn may show a value within tolerance. And, the shorted turn won't show up with a meter. Only the patented ringing test will isolate coils with shorted turns. To test inductors reliably, you must test them for value, tolerance and quality (ringing).



### Inductor Quality (Ringing)

The Ringer test checks for the ability of the coil to work in the circuit. Each type of coil behaves differently; therefore, six separate circuits are used to match the coil being tested to Sencore's patented ringing test circuits. Only the 4 red positions on early Z Meters are used for yokes, flybacks and switching transformers. All six positions are used for other inductors. Ten or more rings proves that the coil under test has no shorted turns.

Only the triple patented LC77 AUTO-Z automates the ringing test to eliminate switching and interpretation. You get the answer automatically, "good" or "bad", at the touch of a button.



**Fig. 7:** The equivalent series resistance (ESR) is the combination of all electrical resistances, including the leads, plates, connections, and water in the electrolyte.



### Equivalent Series Resistance (ESR)

Engineering books in the early 40s discussed ESR, but it wasn't until the electrolytic capacitor's physical

## 2. How does the AUTO-Z prevent me from misinterpreting, making embarrassing errors, or paying for costly downtime?

You simply pick up the information off the component, enter it into the AUTO-Z keyboard and it automatically tells you if the component is "good" or "bad" to EIA and industry specs, without calculations, interpretations, look-ups, or errors (See Figure 8).

Each time you push a TEST button, the AUTO-Z internal microprocessor automatically ...

- Checks whether the component is shorted or open; if so, it immediately tells you so and stops the test.
- Looks up the proper EIA and industry specifications (stored in memory) according to the component's type, value, voltage, and tolerance.
- Tests the component.
- Makes the necessary calculations and interpretations
- Compares the test results to the looked-up EIA and industry standards.
- Displays the results on the LCD readout with GOOD or BAD, depending on whether the component passed or failed.



Fig. 8: The AUTO-Z automatically tells you whether the component is "GOOD" or "BAD", without look-ups, calculation, interpretation, or chance of error.

many capacitors as you wish, changing only the parameters that are different for the next test.

- Test the capacitor in any order you want by pushing the TEST buttons.

Test results and "GOOD" or "BAD" are shown on the AUTO-Z's LCD display in seconds, with no need for calculations, look-ups, or interpretations. Plus, there's no chance for error.

#### 4. I've learned that dielectric absorption shows up after testing for value, leakage, and then value again. What's to stop me from making these tests in the wrong order with the AUTO-Z?

The dielectric absorption test on the AUTO-Z is a simple, one-button test that can be made at any time, in any order with the other tests. The order of testing you choose can give you definite advantages. For example, by testing for dielectric absorption first, you'll be able to see if applying full rated voltage during the leakage test changed the reading. This is particularly important when verifying that a re-formed capacitor off the shelf is ready for continued use. When testing for leakage first, the capacitor's dielectric may retain some charge. The AUTO-Z automatically checks to see if the capacitor is charged and delays the dielectric absorption test until the charge has been bled off (Tech Tips 101 through 106 give detailed information about capacitors, coils, and the LC77 AUTO-Z. Ask your Sales Engineer the next time you call, or see enclosed return card.)

#### 5. Can I operate the AUTO-Z like I do the other Z Meters if I just want to know capacitance value, for instance?

You don't need to enter all the parameters if you only want a fast reading. Yes, you can simply press the desired test button. You may, for example, wish to test an inductor over its tuning range when troubleshooting a difficult circuit. In this case, simply push the INDUCTOR button and observe the value as you adjust the inductor.

When using the AUTO-Z this way, you still have the advantages of autozeroing, precise selection of the rated test voltage, and the choice of making tests in any order you prefer.

#### 6. The AUTO-Z sounds like it's a cinch to operate, but how can I be sure I can operate it correctly every time?

Despite the AUTO-Z's superior capabilities, it is very user friendly.

Simply hook-up the component you wish to test, and press the button; it's that easy. And, if you try to perform a test incorrectly, an error message shows on the LCD display to alert you to the exact problem. With the AUTO-Z, you'll never get misleading test results.



Fig. 9: If you try to perform a test incorrectly, an error message shows on the LCD display to alert you to the exact problem. Each error message is explained in the AUTO-Z's handy pull chart.

#### 7. I'm getting both much larger and much smaller capacitors in my business. How can I be sure the AUTO-Z won't become obsolete?

You'll be able to test all the capacitors and inductors *large and small* used in modern circuitry with the LC77's extended capacitance range. Large value aluminum electrolytics are being used for low-voltage power supply filtering, and new high-technology double layer electrolytics (commonly a Farad or larger) are used instead of batteries for memory back-up in microprocessor operated equipment.

Smaller capacitors and coils are found in RF, IF, Video, Industrial, and biomedical applications. Capacitance values are often about 5 pF, with coils as low as 4 or 5 uH. To stay ahead of advancements in new technologies, the LC77 AUTO-Z ranges were extended, compared to previous Z Meters. The LC77 measures capacitors from 1.0 pF (with 0.1 pF resolution) to 20 F, and inductors from 1.0 uH to 20 H.



Fig. 10: The AUTO-Z includes test ranges that cover every capacitor or coil you'll want to test, now or in the future. No other tester measures caps from 1.0 pF to 20F and coils from 1 uH to 20 H.

Want to check a capacitor whose value is less than 1 pF? Only the AUTO-Z, with its 0.1 pF resolution, lets you do it. Here's how:

- Use the AUTO-Z to measure a reference 10 pF capacitor.
- Add your unknown capacitor in parallel with the reference and measure it again.
- The AUTO-Z shows your unknown capacitor as an increase in value over the reference with resolution to 0.1 pF.

#### 8. Can I use the AUTO-Z to reform electrolytics?

Yes, you can use the AUTO-Z leakage test power supply to reform the oxide dielectric in electrolytic capacitors that have developed leakage after sitting unused for long periods of time. This is often the case with new capacitors that have been sitting on the shelf. Unless these capacitors are reformed with a current limited supply before being put into circuits, they may fail. The worst time for them to fail (and according to Murphy's Law that's when they will) is after the customer has picked up his set.

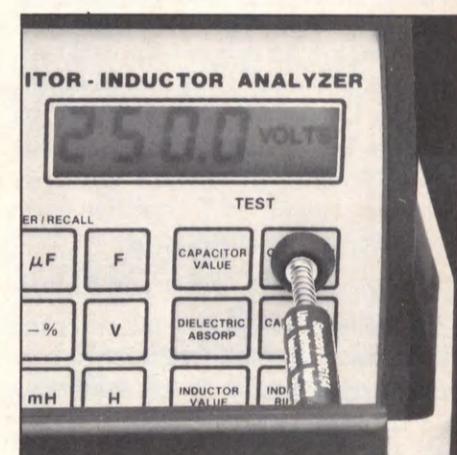


Fig. 11: The leakage test function of the LC77 is a convenient current limited voltage source that can reform aluminum electrolytics to their rated voltage.

Use the supplied Test Button Hold Down Rod to keep the CAPACITOR LEAKAGE test button depressed while you are reforming the capacitor. The hold down rod, rather than a latching switch, is used as a safety reminder to you and others that voltage is being applied to the test leads.

#### 9. Are there other uses for the AUTO-Z's impressive 0.1 volt/step power supply?

Often, you'll need a precision, selectable DC voltage source to substitute into critical reference circuits or as a bias supply when troubleshooting direct coupled circuits.

The AUTO-Z leakage power supply gives you portable precision power to 1,000 volts DC. To use this

#### 3. The AUTO-Z sounds simple, but the front panel looks complex. Can you take me through a quick test?

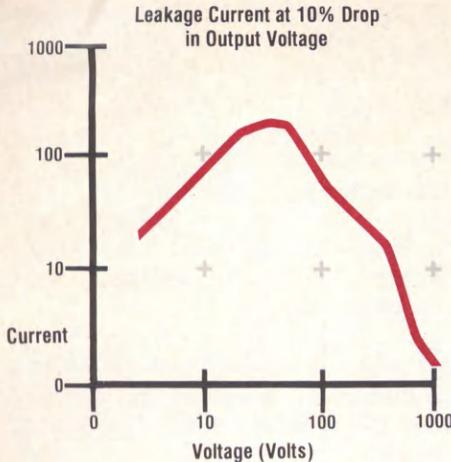
Automatic testing with the AUTO-Z is fast. To automatically test a .033 microfarad, +5%, 100 volt film capacitor for example, simply:

- Select the component type.

Use the handy pull chart as a guide to help you identify component type. In this case, the cap is not an electrolytic or ceramic, so select the ALL OTHER CAPS button.

- Enter the parameters. Using the color-coordinated keys, enter the value, tolerance, and voltage rating of the capacitor you are testing, which is just as easy as entering numbers into a pocket calculator.

Enter .033 and then uF on the LC77's keypad, followed by the capacitor's tolerance and rated voltage. After entering the information once, you can test as



**Fig. 12:** Use the power supply for troubleshooting reference circuits, biasing amplifiers, testing high voltage metering circuits, powering small units on the bench, etc. The graph above shows approximate current available.

feature, simply enter the desired voltage on the keypad and use the "hold down rod" to keep the CAPACITOR LEAKAGE button depressed. The current drawn by the circuit connected to the AUTO-Z is displayed on the LCD display up to 19.9 ma.

Greater current causes the LCD to show overrange. The LC77's leakage power supply is current limited and can't be damaged by short circuits. Figure 12 shows the amount of current the leakage power supply provides at different voltages.

## 10. Will the AUTO-Z's leakage supply work for hi-pot testing, and will it dynamically test high value resistors I can't check with my ohmmeter?

The same leakage supply that dynamically tests capacitors at their full rated voltage also lets you reliably test other high-voltage components. Test high-voltage diodes, transistors, SCRs, triacs, transmission lines, transformers, printed circuits, switches etc. In fact, you can test any component for leakage to 1,000 VDC, and get the readout in current or ohms to 1,000 Megohms.



**Fig. 13:** High voltage resistors are above the range of ohmmeters; the AUTO-Z measures leakage to 1,000 Volts, with the readout you need. Simply select CURRENT or OHMS to analyze leakage or resistance to 1,000 Megohms.

Do you recall trying to test high voltage diodes, for instance? You couldn't turn them on with your ohmmeter could you? High voltage diodes are made of many diodes in series, each junction needing 0.7 V to turn on. The voltage available from an ohmmeter simply isn't enough to forward bias the diodes, let alone check them for breakdown to 1,000 volts.

## 11. What about the SCR250 SCR and triac tester? Will it still operate with the AUTO-Z?

Yes, the SCR250 works great with the AUTO-Z, as it does with any Sencore Z Meter. The SCR250 tests SCRs and triacs for leakage (to 1,000 V) and turn-on without complicated setups. The SCR250 is battery operated, so it's a perfect companion to the battery operated LC77 AUTO-Z. Plus, it fits in the Z Meter carrying case for portable dynamic testing of SCRs and triacs anywhere, anytime.

## 12. How can the AUTO-Z possibly give me up to 1,000 VDC output and still be truly portable?

Battery operation with 1,000 VDC output does sound almost too good to be true. In fact, when we first talked about building a battery-operated Z Meter with 1,000 V output in 0.1 Volt steps (keeping it small for use in the field or on a mountain top), the engineers almost choked on hidden laughter. But one young engineer, after thinking a bit, braved the silence. He said "by using new technology and innovative circuits, it might work."

This farsighted engineer designed a special switching power supply that delivers up to 1,000 VDC from a 12 VDC battery - a common battery found in many portable VCR's. His design is very special indeed. It's built into the AUTO-Z, and the PORTA-Z (LC76), to make them the first and only truly portable, dynamic LCR testers on the market.

## The power supply is regulated to +0, -5% so you always know what the output voltage is.

The portability of the AUTO-Z lets you test transmission lines, remote communications or industrial equipment, or gives you the option of battery operation when you simply don't want to drag a tangled extension cord around.

An AUTO-Z weighs less than eight pounds in its rugged carrying case (optional). Take the AUTO-Z wherever you need powerful troubleshooting capability. At the bench, plug the supplied power adaptor/recharger into 120 VAC for use as a bench instrument, with or without the battery. The auto-off circuit, which turns the AUTO-Z off



**Fig. 14:** Battery operation lets you analyze capacitors, coils, resistors, and transmission lines in the field or on a mountain top - 1,000 VDC test output makes the Z Meter the only portable dynamic LCR tester on the market.

15 to 20 minutes after its last use (in case you forgot), is bypassed when you use the AC power adaptor.

## 13. But, will the AUTO-Z run a full day on the battery, or will I have to carry spares, or recharge the battery during my testing?

The AUTO-Z uses a standard lead-acid plug-in battery (BY234) which typically gives you a full 9 hours on a single charge (exact battery life depends on which tests you are using). There's no need to worry about spares - although for jobs far away from your shop you could carry a fresh battery to plug in for another 9 hours of portable testing.

When your workday is finished, simply plug in the supplied AC power adaptor/recharger to recharge the battery. The next day, your AUTO-Z will be ready for another full day's portable use.



**Fig. 16:** The AUTO-Z's built-in computer is easily adapted to the IEEE488 Interface bus. Use your personal computer to add automatic Z Meter applications to your test system.

cap/coil tests that Z Meter owners value so highly, but now with the LC77 you won't be wasting time with calculations, interpretations, look-ups or errors. The built-in AUTO-Z computer handles the look-up charts, tolerance calculations, and test interpretations for you.

## 15. If the AUTO-Z is as automated as it sounds, will I be able to use it with the rest of my automated test equipment?

Yes, the AUTO-Z is perfect for use in automated testing. Use the optional IB72 IEEE488 Bus Interface Accessory to adapt your AUTO-Z to the IEEE488 Bus. Then, you can collect and store component test data, automate testing, or use your computer/controller to guide your people through unfamiliar testing. Your AUTO-Z adds leakage, cap value, dielectric absorption, inductor value, and inductor ringer to the IEEE488 Bus. These tests were not available on IEEE488 before the AUTO-Z.



**Fig. 16:** The AUTO-Z's built-in computer is easily adapted to the IEEE488 Interface bus. Use your personal computer to add automatic Z Meter applications to your test system.

In each case, the AUTO-Z's internal microprocessor uses the component's value, voltage, and tolerance to automatically test against EIA and industry standards. You don't have to worry about choosing the wrong look-up chart, doing time-consuming calculations, interpreting test results, making costly errors, or spending needless time holding down a button beyond the time actually needed for the test.

## 16. If I go ahead, how can I be sure I'll be able to troubleshoot components profitably the way you say?

A quick look in the LC77 manual brings all the confidence you need for immediate operation. It's a comprehensive, easy-to-follow operation and application guide that covers about everything you'll want to know about capacitors and coils. And, for those special applications, Sencore Application Engineers are only a WATS FREE phone call

## 14. Can I think of the AUTO-Z as a regular Z Meter that's portable and has a built-in computer programmed to compare the component I'm testing to EIA and industry standards?

You've described the AUTO-Z exactly. It includes all the dynamic

away (1-800-843-3338). Plus, the Sencore News and new Tech Tips keep you up to date with timely articles on troubleshooting, electronics theory, and instrument applications.

For more than 37 years our dedicated customers have kept us

aware of problems they are experiencing in the field. These same professionals have talked to us at seminars and workshops nationwide. And, we have used their input to build better products. That's why we know the LC77 AUTO-Z can help solve your cap/coil analyzing problems.

With Sencore, you get a "no questions asked" 30 day money back guarantee. Plus every Sencore product manufactured since 1975 is backed by Sencore's exclusive 100% Made Right Lifetime Guarantee. And, for a limited time, you can take advantage of the LC77 AUTO-Z

introductory 10 Day "Try Before You Buy" Self Demo.

Questions? Call 1-800-843-3338 and tell the phone operator your area code. She will put you in touch with your sales engineer, your friend at the factory, and it won't cost you a cent.

## Once You Own One, You'll Never Give Up Your Z Meter

Perhaps you'll recognize yourself in this too often repeated comedy of common profit robbing errors.

It's 3:10 P.M. on Thursday. You're feverishly working on a high fidelity amplifier for your local Baptist church. Sunday is coming up and the church amplifier system went out during the Wednesday night service.

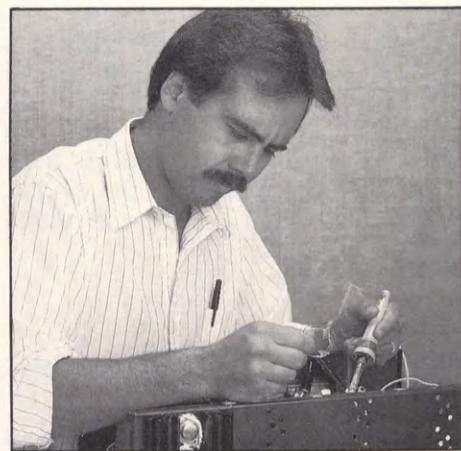
Sure, Deacon Jones got a little too emotional, shouted "Praise the Lord" into the "mic" at the top of his voice and caused an overload, but that's beside the point. The amp came into your shop on Thursday with the smiling Deacon Jones saying "and don't forget, we must have this system back and working Sunday!"

You've traced the problem to the output stage on one of the balanced push-pull, direct-coupled amplifiers. A quick check of the DC voltages showed that the B+ was low and not evenly distributed between the two stages. And, there was that hum in one of the speakers, which makes you think that one of those large electrolytics in the output supply is defective.

You unhook one of the 2,000 microfarad, 150 Volt electrolytics and look for a substitute. You hunt through your stock of electrolytics and swear that you're going to have to invest in more inventory, because the only value close to 2,000 microfarads is a 50 Volt electrolytic and you know you can't substitute that — or it might blow up.

So, in desperation, you dig through your old junk box and, sure enough, there is a 1,500 microfarad, 450 volt capacitor. Now, you know you're at least 25% off in value and 300 volts high in rated voltage. You painfully remember that you need to operate electrolytics close to their operating voltage or they will change value. But, throwing caution to the wind, you connect the "junk box dog" into your circuit, and do you know what? The hum got worse and the DC voltage didn't change much.

Well, time is getting short and you have to get this repair back to Deacon Jones, so you push forward. You toss your substitute back into the junk box and begin to get "analysis paralysis" (shotgunning begins to look like a good idea) as you try almost everything humanly possible to repair that output. Aha! You remember that you have some



**Substituting components from your "junk box" makes matters worse as you unknowingly substitute good parts for good or bad parts for bad.**

substitute power transistors. You quickly substitute the outputs, one at a time, to no avail.

With eyeballs that are beginning to drift in circles, you start scoping out the B+ supply, as it looks more and more like this is your culprit. "But, it couldn't be . . ." you remind yourself, "I changed the filter capacitor and it didn't help." You begin to wonder if you had put a bad one in its place.

Another 20 minutes through your stock and you find three relatively new electrolytics that you can parallel to make up the 2,000 microfarads at 150 V. You tack them in place in disgust, turn on the audio amplifier and sweet music comes forth. "I did put in a bad electrolytic filter!" you suddenly realize. But now it's nearly six o'clock and you've wasted much of the afternoon.

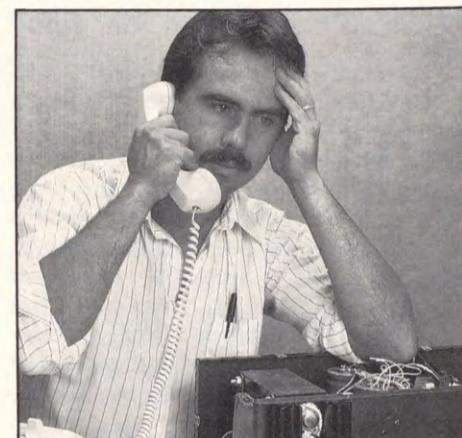
You quickly look at your watch and think "at \$35.00 an hour, I've just spent about \$85.00 that I could've billed to someone else, and I'm right where I started." You solemnly pick up the phone and call your distributor to order the part. The phone rings and rings, and you become more and more frustrated. Finally, someone answers the phone; you ask hopefully, "Hello, could I talk to Fred in the Parts Department?" silence, then . . . "Nope, everyone's gone home," and you realize that you just got the janitor!

Okay, Friday morning will have to do.

You get to work early. Your phone starts to ring and one of the callers is Deacon Jones, checking on the

amplifier. Wow! This is the last person you want to hear from! You tell him that you found out what the trouble is and that you're calling in for the part. He says, "Okay, brother Harold, as long as that amplifier is working on Sunday!"

You make the telephone call to your distributor again. "What!" you exclaim as sweat starts rolling off your forehead from the nervousness of the morning, "The delivery truck has already left for the day and won't be out again until Monday?" Unbelievable! You'd rather do anything than tell Deacon Jones the amplifier won't be ready for Sunday service. What do you tell all the parishioners, some of whom are your good customers, when they find out? Well, the distributor is 84 miles round trip from your house. But, you'd rather do anything than face THAT crowd. So, it's off to the distributor you go.



**You become more and more frustrated when you have to wait on the telephone to your parts distributor.**

"There it is," you scream as you anxiously point to the 2,000 microfarad, 150 Volt electrolytic — just as plain as day right there on the distributor's shelf.

Fred, the parts man, just glares at you in disbelief. "I thought you had just found a dead body," he said. "Man, Harold, you have to learn to take it easy."

"Okay Fred," you say, "put this on my bill; I have to get back." You rush back to the shop, make a good solid connection and turn the amplifier on, just waiting to hear that sweet music again. "Man, is Deacon Jones going to be happy with me!," you think to yourself.

Sputter, sputter, sputter the amplifier goes, and the hum level

**The holder of certificate #322663 call for your FREE Z Meter!**

comes up in the background to keep cadence with the sputter. You must have connected that big electrolytic to the wrong spot, or worse yet, maybe you put it in backwards! A quick check shows that you didn't. You hook up your three parallel substitutes again, and what do you get? It's that sweet, sweet music once more. The new part is bad! And, the distributor has closed by now.

It's Saturday morning, you take care of a few odds and ends and make a bee-line for the parts distributor again. Where did the time go? You barely make it. Out of breath, you rush into the distributor's parts department just before he closes. *You're ready to tear Fred limb from limb.*

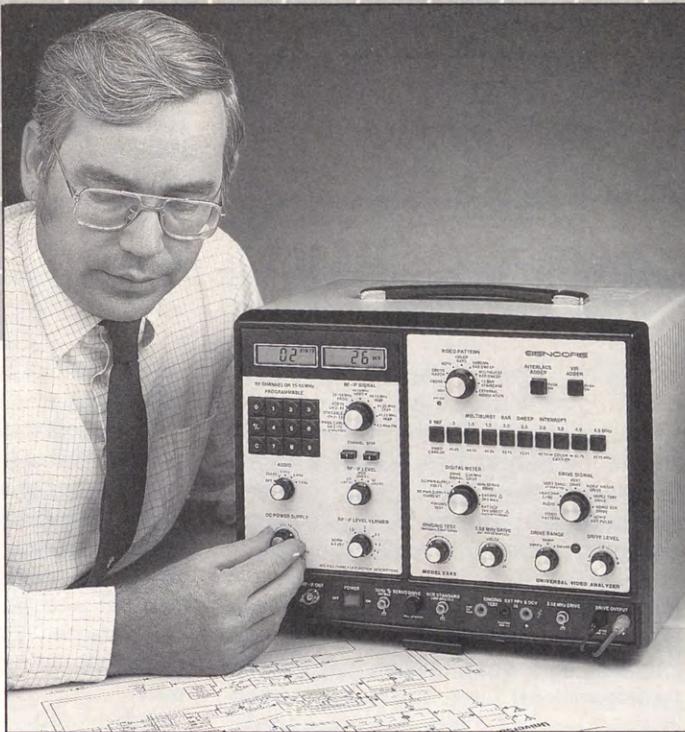
"What do you mean 'that electrolytic was bad'?" Fred asked. Well, Harold, no harm done, we can get full credit so it won't cost us anything and it won't cost you a dime either. You know, Harold, that's a very special electrolytic and we've had it right there on the shelf for about a year and a half, along with one more just like it. Here it is, there won't even be any paperwork. Good luck, Harold."

"Bah"; you limp home, put in the new electrolytic, and eureka!, the sweet music plays once again. Why? Because, for some reason this electrolytic didn't dry out on the shelf.

How could you tell Deacon Jones how much this component and repair job had really cost you; 168 miles on your new van and six wasted hours at \$35.00 an hour. You think, "There's no way I can charge enough to break even."

But now, it's late Saturday night. How are you going to face Deacon Jones at 10:30 at night, when you know the church is locked and old Jones'ee has gone to bed. You have a tough situation — and no solution.

However, there was one solution wasn't there? You could have owned a Z Meter and you would have had your answer in the first 7 minutes, turned a handsome profit, and satisfied a whole church full of people. You could have checked the replacement to make sure, too. You also would have known just what was wrong with the electrolytic so you could have analyzed the circuit better. ■



**H**ave you ever replaced a part in a television only to discover that the set still doesn't work? Have you ever wasted hours testing components in one section of a television only to discover that the problem was actually somewhere else?

There are over 750 electronic components in the average color television. You could repair a television by testing each component until the bad part is found; fortunately, most servicers avoid this time consuming process. Instead, you often draw on past experience, look at the symptoms and make an educated guess as to which stage is bad. Sometimes you're lucky; sometimes not. These unlucky guesses can cause you to waste hours. And, wasted time eats up your profits.

In addition, the complexity of today's television receivers creates a continual challenge to keep up to date with every circuit in every brand of television. With many of these circuits, a problem in any one of a number of circuits can often appear as the same symptom.

Is there a better way? YES THERE IS! It's a troubleshooting technique called functional analyzing. Functional analyzing saves time and spares nerves. Plus, it increases your profits. Functional analyzing reduces the need to study and analyze every circuit. With functional analyzing, you can quickly check out large groups of components rather than spending time analyzing individual circuits. With functional analyzing, you'll use your time more productively by quickly eliminating large sections of the television from suspicion. No need to waste your time testing good components in good circuits.

### What Is Functional Analyzing?

Functional analyzing is a systematic, logical, approach to troubleshooting. Using this method, those false starts and troubleshooting detours, that swallow up your time, are eliminated. Functional analyzing, using the VA62 Universal Video Analyzer, can cut your troubleshooting time in half.

Functional analyzing combines two troubleshooting techniques: signal injection and signal tracing. Known good signals are injected into the television circuits and the results are observed on the CRT or through the speakers. Once the defective stage is located, conventional component testing or signal tracing is used to isolate the bad part. By positively identifying the bad stage, only a few components need to be tested.

Functional analyzing, with the VA62, is a universal troubleshooting technique. It works on all types of TVs, from the old tube type sets to the modern IC set. There is no need to learn a new troubleshooting approach for each chassis from each brand of television. Functional analyzing takes the guesswork out of troubleshooting by quickly verifying which stages are working and which are not.

The VA62 is the key to functional analyzing. It supplies all the signals needed to inject in the circuits found in televisions. But, the real beauty of using the VA62 is that you don't need to disconnect any parts. You can inject a signal into a circuit without removing a single component. The VA62 drive signals are low impedance signals that swamp out the existing signal and then replace it with a known good

## Increase Your Troubleshooting Efficiency 54% With The VA62 Universal Video Analyzer

by Rick Meyer, Application Engineer

signal. You can actually restore a TV to operation using these signals. The swamping feature of the VA62 signal eliminates the need to unsolder a single part. Simply hook the VA62 drive leads to the circuit, adjust the drive output and watch the results on the CRT.

### How Does Functional Analyzing Work?

To get a better understanding of how functional analyzing works, let's look at an example. Imagine that your customer has asked you to repair his TV, an RCA CTC108 chassis. Let's see how you can test this set in the least number of steps.

In the first step, test the television to determine the *general* nature of the problem. You can do this test before removing the back from the set. Here's how: Inject a known good signal from the VA62 into the tuner (at the antenna terminals) and observe the results on the CRT. Using the exclusive VA62 MULTIBURST BAR SWEEP pattern, perform a quick check of the television. When the TV is operating properly, this pattern consists of sharp white lines on a black

background. Note that the video pattern on this TV (Figure 1) does not have detail, indicating that the set has a video problem. This symptom tells you that the problem is somewhere between the tuner and the CRT. Of the 750 electronic parts in this television, this first test has verified that 390 parts are good. Now you simply have to find which of the remaining 360 parts are bad.

The symptom in Figure 1 could be caused by a problem in the tuner, video IF, video detector or video amplifier stage. By injecting a known good video signal from the VA62 at the output of the video detector, you eliminate half the suspected circuitry. In this example the picture quality does not improve. This tells you that the problem is located somewhere after the video detector. Thus, you don't need to look in the tuner, video IF, or detector stage for the source of this problem. This signal injection has eliminated 269 additional parts from suspicion, leaving only 91 parts in question. And, you've done this with only two signal injections!!

The next step is to inject a video signal from the VA62 at the output of the delay line (Figure 2). The

#### 750 components in a typical TV

① Inject a good signal at the antenna input; you get poor video (390 parts are proven good).

#### 360 components remaining

② Inject a good signal at the video detector; no improvement shows the problem is after the video detector (269 more parts are known good).

#### 91 components remaining

③ Inject a good signal at the input of the second video amp; improved picture proves the problem is in the delay line or 1st video amp.

#### 9 components remaining

④ Signal injection proves the first video amp is bad.

Only 5 components left to test!

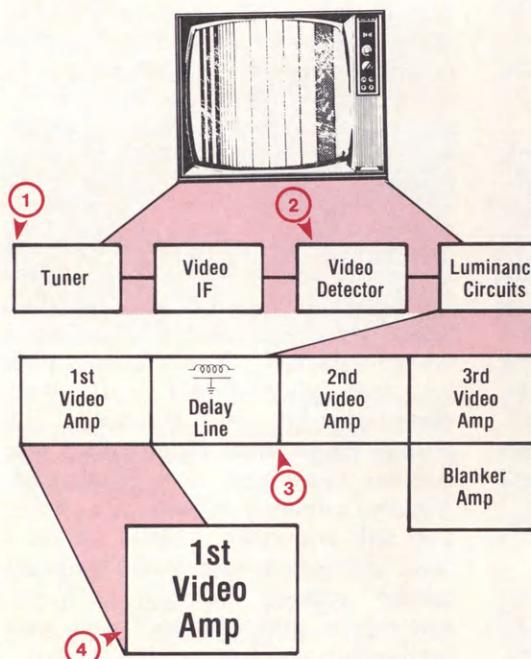
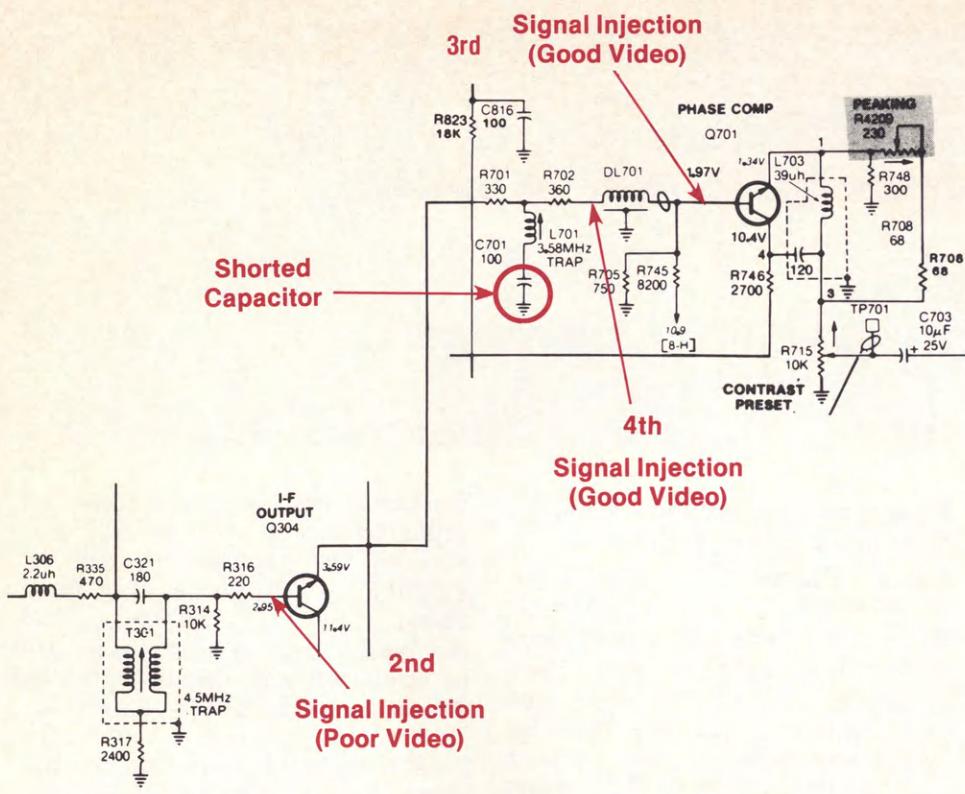


Fig. 1: Functional analyzing quickly isolates defects to the problem stage. You eliminate suspect circuits by injecting known good signals and watching for improvement on the CRT.



**Fig. 2:** The defective stage is quickly isolated with only a few signal injections.

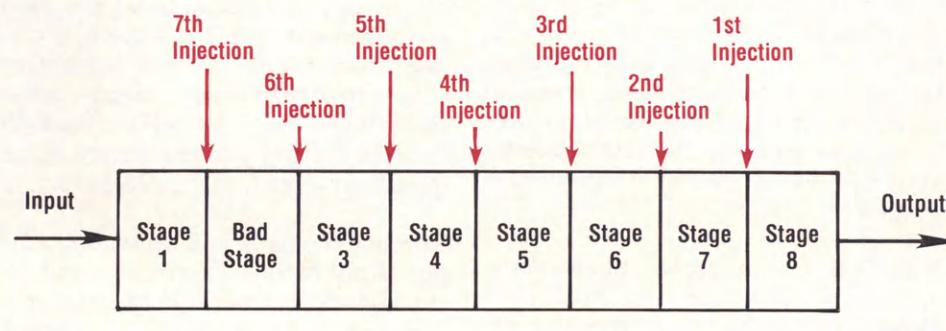
multiburst picture on the CRT is now good. This tells you that the problem is either in the first video amplifier stage or in the delay line. This third signal injection has narrowed the number of suspect parts down to only 9 parts.

Only one more signal injection is needed to determine where the problem is. Injecting a video signal into the input of the delay line, results in an improvement in the picture quality. This verifies that all the circuits after the delay line are working. The only circuit left is the first video amplifier stage. There are only 5 parts that could be defective in this stage (Figure 2). Final testing of these few remaining components locates a shorted capacitor C701. Notice that with a quick performance test and only four signal injections, you have reduced this troubleshooting problem from 750 suspect parts down to 5. What a time savings!

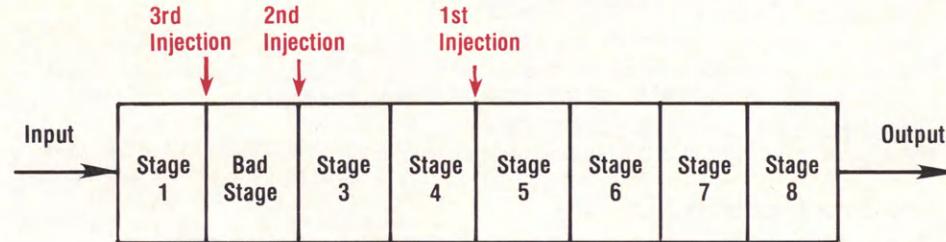
But how much time can you really save every day? The results of a nationwide survey of servicers using the VA62 Universal Video Analyzer, and functional analyzing, prove that your troubleshooting time can be decreased by up to 54%. This means that instead of getting 4 sets out per day, for example, functional analyzing, using the VA62, can help you get out 6 sets per day! Those extra sets serviced are additional profits for your bank account! That's worth a closer look!

### Are There Any Helpful Techniques?

There are a couple of techniques that will help speed up your troubleshooting. First, select a point where the signal makes a major change in form. For instance, one point is where the signal changes from an RF signal to an IF signal. Another point is where the signal



**Fig. 3:** Progressive signal injection often results in the need to perform a number of signal injections.



**Fig. 4:** The divide and conquer technique minimizes the number of signal injections needed thereby saving time.

changes from an IF signal to a video signal. A major improvement in the performance of the television, when a known good signal is injected into the circuits, proves that everything from that injection point on to the CRT, or speaker, is working. If no improvement is seen, then the problem is somewhere between the injection point and the CRT or speaker.

The second time saving technique is called divide and conquer. You could inject signals, starting at the CRT and work back towards the tuner (Figure 3). This method works, but it requires more signal injections than are necessary. Instead, divide the system in half and perform the first signal injection at that point (Figure 4). The first signal injection tells you if the problem is in the first half or in

the second half. Continue to divide the defective half of the system until the problem circuit has been located. In the example (Figures 3, 4), the divide and conquer technique reduced the number of signal injections from 7 to 3. This more than doubled the time saved.

### How Do I Use The VA62 For Functional Analyzing?

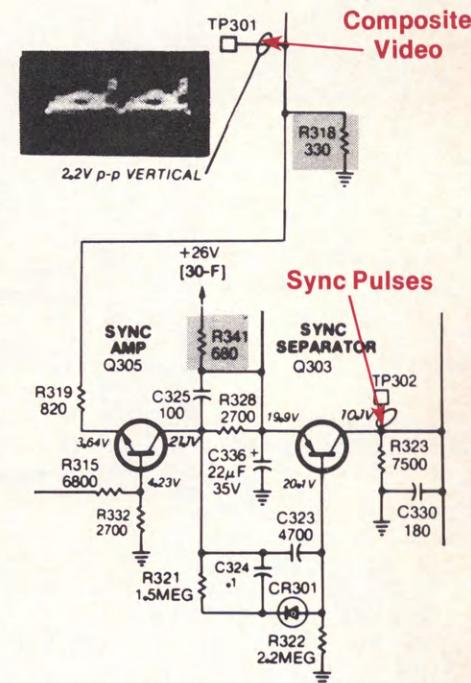
When a television comes in for service, we first need to determine if there really is a problem in the television and, if so, what the symptoms are. This step is called performance testing. To check the overall performance of the television, simply feed an RF signal, from the VA62, into the antenna input terminals of the set. What advantage does this give you?

- You have a known good signal going into the television.
- The VA62 signal and its video pattern can be easily controlled.
- There are no variations in signals from one channel to another, as may be the case in using an over-the-air signal.

Thus, when injecting into the input of the sync circuit, a composite video signal should be used.

### What Signal Level Should I Use?

Here are several tips that will help you determine what signal level to use.



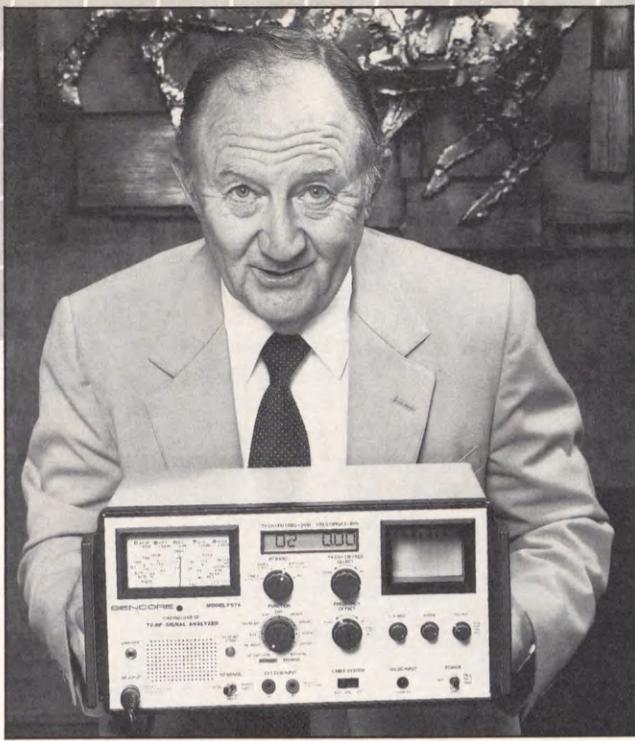
**Fig. 5:** The schematic can often give a clue as to which signal should be injected into a circuit.

1. If a schematic is available, check it for sample waveforms. Schematic waveforms often give the peak-to-peak amplitudes of the signals (Figure 5). Simply set the drive signal of the VA62 to the amplitude shown on the schematic and inject the signal.

2. If no schematic is available, use common sense. For example, You would not expect the base of a transistor to operate with a 300 volt peak-to-peak signal. It will often run in the range of 30 volts or less. Look at a few schematics from other televisions to get familiar with the relative size of signals at various stages in a television. Often other schematics have similar circuits that can be used for comparison.

3. NEVER inject a signal greater than the operating voltage supplied to the circuit. Driving a stage beyond the supply voltage will result in a distortion of the signal or the possibility of overheating the semiconductor in that stage. If no schematic voltages are available, use the DC voltmeter on the VA62 to measure the supply voltage to the stage. Then, use this voltage as the maximum peak-to-peak amplitude of the injection signal.

To profit the most from the time saving benefits of functional analyzing, you need to gain experience. Put your VA62 to work injecting signals into several stages in a working television. When you feel comfortable with functional analyzing, you will be prepared to approach that next tough set with confidence and increased efficiency. ■



## Is Technology Passing You By? Perhaps It's Not Too Late!

by Herb Bowden, Chairman and CEO

**W**hat do you mean, you don't repair VCRs? What do you mean you can't check this new TV stereo, you sold it to me, didn't you? Don't tell me you can't fix my new car AM stereo or at least tell me if it is working? These are the echoes of angry customers who are beginning to pass you by if you are letting technology pass you by. Are you recognizing these calls as a problem or an opportunity to expand and grow?

Naturally, the same thing is happening in communications, audio, industrial repair, and in the classroom, too. Sure, it's hard to keep up, but is that an excuse — or a reason? My definition of an excuse is something that we had control of but did nothing about. A reason is something that we could not control but happened. Excuses are made by people who don't plan; reasons are given by those whose plans went awry.

### You Can Plan Your Business Future

Perhaps it's time for each of us to take a look at the person we are, the technical operations we are running or the business we are conducting. Let's test ourselves, to see which category we fit into, and then decide what to do about it. Can we plan our future? A planner is out ahead of the others and gets the lion's share of business. He or she is proactive instead of reactive. They realize that every morning that they come to work they will respond to one of two things, a plan or a problem. If they react to a plan, they are proactive. If they only take care of things as they come, they are troubleshooters, never have time to plan or get ahead, and are usually in trouble.

### Opportunities Are There; Are You Properly Prepared?

Were you one of the first to service solid state? Were you one of the first

to study and equip your shop for color TV, or did you wait until customers demanded service? Are you first in TV stereo? Or, are you waiting until you get into demand trouble, and perhaps have already missed most of the warranty service in the area as manufacturers passed you by as a possible warranty station?

What are you doing to update your shop for video service from just TV? Have you realized that there is as much or more work in VCRs, stereo TVs, closed circuit TV, monitors, camera, camcorder repair, video games, and security systems, as there is in TV and most of it will stand a heavier service charge? Have you ordered a new business sign that says VIDEO SERVICE and taken down the outdated Radio TV sign?

### Are You Updating In The Right Places?

Have you taken a good look at the Sencore video package, which is recommended by most TV manufacturers for warranty repair, as shown in this Sencore News issue, and realize that you can update your shop for less than the cost of your delivery van? What's more, you can update your shop for less than half the cost of a delivery boy per week! Which is the most valuable to you? Have you been updating in the wrong places?

Video is spreading to the majority of households through CATV and to apartments, motels, and hotels with MATV. Are you going to let video service pass you by especially when Sencore is making an exclusive offer to give you the all new, all channel, FS74 CHANNELIZER SR., which is guaranteed to help you find every single problem in any CATV or MATV system to FCC standards, absolutely **FREE OF CHARGE** if you update to the Sencore Success Service Center package today?

### Progressive Servicers Use Sencore's "Pay As You Grow" Plan

Believe me, I was thinking of those of you who suddenly say "Let's update and go all the way," and those who want all they need for inside and outside video service from the only company that makes the whole video line — Sencore, when I approved this once-in-a-lifetime updating package, along with the bank financing for you so you could "pay as you grow." Sure, this may sound like a commercial, and it is, but I am dead serious about it. What's more, if you don't find me 100 percent correct, or you change your mind after receiving the Sencore Success Service Center, you can return it, no questions asked, within 30 days.

Further, we back you up technically; our Application Engineers will be through your area holding seminars and will write many technical articles on each of these products as they apply to TV, VCRs, and Stereo TV in upcoming Sencore News

#### Consumer Electronics Growth Creates Exciting Servicing Opportunities—Why Let Them Pass You By?

1977 Personal Computer • 1982 AM Stereo  
• 1983 Compact Disk Audio • 1984 TV  
MTS Tests Begin • 1985 Camcorders  
Introduced • 1986 Service Industry Shifts  
From TV To Video • 1987 Service  
Opportunities Boom • VCR • Stereo TV •  
AM Stereo • Functional Chip Analyzing •  
and Automatic Waveform Analyzing

issues. More so, you can call our Application Engineers for assistance, absolutely free of charge, at any time. We will also produce a number of very helpful VCR tapes this fall. They will be announced in the Sencore News.

### But, How Do You Prepare For New Opportunities?

Firstly, study the new systems; you should read every VCR service article that you can find until you know VCRs forward and backward. That's why we have VCR servicing articles in nearly every Sencore News.

We have explained the complex stereo TV system in detail in recent issues. Plus, we have printed this material in a booklet, available free of charge, upon request. Early 1988

Sencore News issues will have full explanations of AM Stereo, and Sencore test equipment will be available to help you at that time. These new systems and troubleshooting methods will also be explained and demonstrated at Sencore seminars.

Lastly, learn how to troubleshoot these systems by ordering the necessary test equipment, taking a good chassis, learning how to performance test it and then putting troubles in and taking them out. That test equipment must be shipped with full explanations of the circuits that you are going to work on and tell you clearly how to troubleshoot them.

### Profit Increase Is Predicted For Shops That Service Stereo TV

By now, you have taken a very serious look at the Sencore ST65 and ST66 stereo TV analyzers. Most TV stations are switching to stereo TV this fall and all networks are carrying stereo TV. The market is there, are you ready? Or are you going to be lagging behind your competition once more? Why not wait until you get enough stereo TVs in for repair you say? I'll tell you.

Firstly, so that you can get ahead of your competition and because it has been repeatedly reported, from coast-to-coast, that most stereo TV receivers do not have the separation that they are supposed to when delivered brand new. Customers are often unhappy with their TV stereo performance, casting a shadow of doubt on you, me and the industry.

Our Application Engineers tell us that they are getting more than a call a day from those who own an ST65 or ST66 advising them that all of one brand or another needs to be realigned to satisfy the customer. Secondly, Sencore engineers learned, when field testing the ST65 and ST66, that the internal modulation level recommended in TV manufacturers' service manuals was indeed the wrong level and would not work.

A formal letter was sent to industry service departments advising them that our findings indicated that we must be at 50 percent modulation, for the circuits to function normally, but that most TV manufacturers recommendations and competitive

(continued on page 26)

# Sencore Buyer's Guide

**Are you looking for success in Electronic Servicing?  
Then welcome to the Sencore Buyer's Guide.**

**For over 37 years,** Sencore has been dedicated to just one goal — making you more successful in Electronic Servicing. We're proud to say that we plan on sticking to this simple, yet important, mission. You see, as we phase into our second generation of leadership, we realize that your success truly will mean a successful future for Sencore as well.

**When you say "yes" to Sencore,** you're saying "yes" to good old American ingenuity at its finest. With 93% of Sencore's product line holding at least one patent, you're assured of exclusive, time-saving, money-making features not available anywhere else. You see, Sencore instruments are designed by practical troubleshooting pros - for practical troubleshooting pros. That's why you can count on Sencore for test equipment that saves you that all-important analyzing time.

**Sencore's engineers know from experience** that as an Electronic Servicing Professional, your time really is money. Lost or wasted time is money right out of your pocket. Our designers know that every time you have to fiddle with a knob, connect and reconnect leads, or come up with an inconclusive or misleading test result, it costs you dearly. That's why as you review the Sencore product line, you'll notice that each Sencore instrument has a fresh, uncluttered, easy-to-use look. Computer aided design and manufacturing puts the complex electronics on the inside to help keep your operation simplified on the outside.

**Each unit is 100% Made Right** in America's heartland by skilled craftsmen who have your troubleshooting needs in mind. That's why Sencore products are literally world renowned for their toughness, quality, innovation, and outstanding value. Less than 2% are returned for warranty service.

## Dealing Direct With The Sencore Factory Adds To Your Success

**Unlike others, Sencore's commitment to your success** just begins at the delivery dock. Consider that one number, **1-800-843-3338**, connects you, 24 hours a day, to a factory full of friendly folks dedicated to making you and your business more successful. You get fast, friendly product delivery; most items are in stock and are shipped within 48 hours of receipt of your order. Our exclusive "Pay As You Grow" Investment Plan will put you in your Dream Shop for just dollars a day. So you literally pay as your Sencore instruments help you grow and prosper. That's why saying "yes" to Sencore is saying "yes" to your future success.

**Your service after the sale** is second to none in any industry. Our standard 72-hour turn-around on service repairs and 48 hours on parts means maximum up-time and productivity from each instrument. Plus, since our Engineering, Service, and Quality Assurance organizations are under one roof your serviced instrument is renovated to better-than-new performance with the latest engineering updates; is refurbished to like-new appearance; and undergoes final aging and quality checks just like our new units - all at no extra cost. Best of all, you can be sure your serviced instrument is right on specifications, as each unit is calibrated against Sencore's NBS traceable Prime Standards Laboratory.

**Sencore's industry exclusive** Sencore News, Application Bulletins, Field Workshops, and helpful Application Engineers guarantee that you'll be getting the most from your investment. Our newly added, state of the art, video production studio will even add a new dimension to your after the sale application support, with both operaton and training tapes. Our obligation and support is just beginning, instead of ending, when you say "yes" to test equipment from Sencore.

## Your Success Is Guaranteed

**You can't make a wrong buying decision** when you say "yes" to investing in Sencore. You're not investing in just an

instrument; you're investing in your own piece of an entire organization dedicated to making you more successful.

**The same WATS Free success number, 1-800-843-3338,** that connects you to a fast, friendly Sales Engineer, also connects you to our Application Engineers for technical consultation, Service Technicians for quick field repair tips, and our Telemarketing Engineers for after the sale follow through—all at no added expense to you. You simply need to pick up the phone and ask.

**Since every Sencore unit has quality built in** and not troubleshoot out, only Sencore offers you a 100% Lifetime Made Right Guarantee. This exclusive Buyer Protection Plan assures you that your unit was engineered and manufactured right the first time - or we'll make it right - for the lifetime of the instrument, at no cost to you. It even guards your instruments for a lifetime against rusting out - so plan on profiting from your Sencore investment for a long time.

**Finally, Sencore's no nonsense 30 Day Money Back Guarantee** assures you that you've made the right choice. Every Sencore instrument and accessory is covered by the industry exclusive guarantee of satisfaction. Simply stated—if you're not 100% satisfied with your Sencore instrument, return it for a full refund—including freight both ways—and

owe nothing. You're always sure that you've "bought right" when you say "yes" to a Sencore investment.

**Start up the road to success right now**, by calling us at **1-800-843-3338** and let us put you in your own Sencore Dream Shop.

*R. Herb Bowden*

Herb Bowden/CEO

## Special Terms Makes Owning Sencore Instruments Easy

**One more big reason to act now, Sencore's "Buy Now Pay Later" program!** That's right, you can own any Sencore instrument now, during the busy time of the year, and have 90 days before your investment is due and payable.

**Own any Sencore instrument with our special "Pay As You Grow"** monthly investment plan. Sencore offers special monthly investment programs for all of our instruments and package deals. Owning the best is easy with this exclusive plan. Simply call **WATS FREE 1-800-843-3338**, and ask for your Area Sales Engineer for more information.

**Save even more with super holiday specials!** That's right, you can save even more this holiday season with great package deals, you can save up to 19.2%! See the last two pages of the News for more details!

**CUT HERE AND MAIL TODAY**

**Use this form to renew your**

## Sencore News Subscription

The Sencore News is available to our customers at no cost if they own Sencore products. To qualify for a free Sencore News subscription, simply fill in below the instruments you own. If you do not own Sencore products, but wish to receive the News, you can qualify by indicating what Sencore instruments you will invest in during the next 12 months. If you do not plan on investing in Sencore instruments in the next 12 months, you can receive the News by enclosing \$20.00 with this form.

**YES, I own these Sencore products, please send me my free subscription.**

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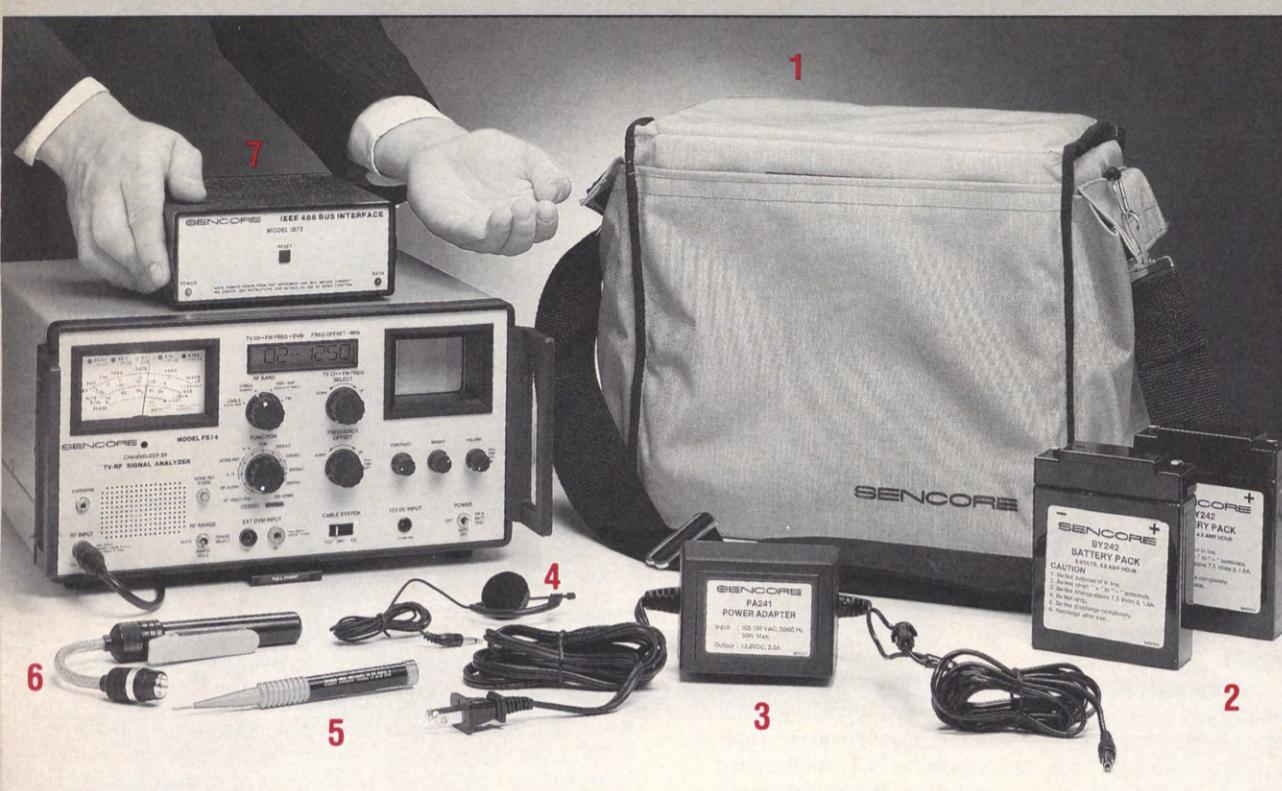
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3200 Sencore Drive

Sioux Falls, SD 57107

# Completely Analyze CATV, SMATV And RF Distribution Systems Anytime, Anywhere And Under Any Conditions.



The FS74 CHANNELIZER SR. delivers the ultimate in RF distribution troubleshooting and performance testing. Exclusive tests allow you to completely and automatically analyze every channel to full FCC specifications and the tests are performed completely "on-channel", so you get simple and accurate results. Plus, you can add to your FS74's versatility with a complete line of accessories that allow you to tailor your FS74 to whatever situation you'll run into.

**1) CC244** - The FS74's carrying case provides weatherproof protection for the CHANNELIZER SR. and quickly turns the FS74 into an easily portable troubleshooter that you can take anywhere. Plus, the side pockets give you extra room for storage of other accessories. **\$148.00**

**2) BY242** - These optional battery packs provide hours of continuous operation without the need for an AC or DC power supply. These packs give you the versatility

you need for those quick system test needs that suddenly arise. **\$44.00**

**3) PA241** - This AC power adaptor allows you to recharge the FS74's battery packs overnight, so you're ready to go the next morning. **\$48.00**

**4) HF247** - This handy earphone allows you to detect subtle audio problems in a high noise area. It also lets you bypass the meter's speaker when you need quiet testing. **\$9.95**

**5) RE248** - The optional range extender probe for the FS74's built-in DVM give you the ability to test voltages up to 2000 volts and protect your meter from line surges. **\$19.95**

**6) PL246** - This simple but effective snap-on panel light gives you clear illumination of the entire front panel unlike backlit meters. Take this accessory with you when darkness sets in for troubleshooting anytime. **\$9.95**

**7) IB72** - Expand your meter's capabilities to computer operation to perform remote head-end tests through phone modems, or for system performance documentation. This IEEE 488 interface adapter gives you the versatility to automate your system tests for easier and more accurate test results. **\$625.00**

The FS74's exclusive, patented tests allow you to easily and completely analyze problems. Plus these optional accessories give you the added flexibility you need to analyze RF distribution systems anytime and anywhere.

## FS73 CHANNELIZER JR.™ TV-RF Performance Tester



### Make Difficult Performance Tests In Any RF Distribution System 100% Automatically

- NEW All Channel Digital Tuner
- NEW Exclusive 5 Microvolt Sensitivity And Automatic Attenuator/Ranging
- NEW Automatic Microprocessor Controlled:
  - Fine tuning with readout of frequency off channel
  - HRC and ICC cable system shifts
  - On-channel Signal-to-Noise test

- Audio-to-Video carrier ratio test
- Hum test on any in-use channel

### FS73 CHANNELIZER JR. TV-RF Performance Tester **\$2395 Patented**

On GSA Contract



Now You Can Completely Performance Test Every Single TV Channel, In Any RF Distribution System, To FCC Specifications, 100% Automatically And 100% Faster Than Ever Before.

**Discover fully automated tests on all channels to FCC specifications.** No more guessing or correction factors to worry about. Eliminate the tuning, measuring and calculating to find RF levels, audio-to-video ratios, signal-to-noise, and hum. The FS73's microprocessor does these for you automatically, on any channel from 5 to 890 MHz. Perform exclusive signal-to-noise tests, automatic audio-to-video ratio and hum tests on any in-

use channel. No more tuning to dead spots or unused carriers.

**Discover the power of microprocessor control and super sensitivity.** Measure signals all the way down to 5 microvolts, without switching attenuator positions. The FS73's microprocessor does it all! Plus, the special AFT circuits pull in the carrier and digitally tell you how

far it is from its assigned carrier. Test for HRC and ICC shifts instantly with the flip of a switch.

**Automate your system tests.** A special IEEE 488 interface allows you to computer control system tests for remote and long-term monitoring. Uses the optional IB72 interface accessory.

**New**

- All Channel (Cable, HRC, ICC, VHF, UHF, FM) Digital Tuner And LCD Channel Readout
- Exclusive 5 Microvolt Sensitivity On All Channels With Autoranged Attenuator
- Exclusive, Automatic Or Manual Fine Tuning With Off-channel Frequency Readout
- Exclusive, Automatic Hum And (Patented) Signal-to-Noise Tests On Any In-Use Channel
- Exclusive Picture Quality Check With Integrated Wide Band Monitor
- Exclusive ACV/DCV Measurements Through RF Input Or Special DVM Input

**FS74 CHANNELIZER SR.**  
TV-RF Signal Analyzer  
**\$3495 Patented**

On GSA Contract



*"(The FS74) is a tremendous help . . . It allows us to readily see the (interfering) signal and locate its source and get it out of the system."*

**Joe H. Floyd**  
Vice-President  
Midcontinent Cable



**Finally You Can Thoroughly Analyze And Pinpoint Any RF Video Trouble In Any RF Video Distribution System - Accurately And Automatically - In 1/2 The Time.**

Now, locate any problem in any CATV, SMATV or RF distribution system quickly and accurately, plus test to full FCC specifications. Now you can locate elusive ghosts, signal ingress, and beat problems that all other signal level meters miss with the FS74's exclusive system troubleshooting ability. The FS74 gives you every function you need to completely test all aspects of system performance to FCC specifications, including RF level, Signal-to-Noise, Hum, and Audio/Video separation; and it does it 100% automatically. Plus, the FS74 gives you the ability to troubleshoot the system to locate the problem with its exclusive built-in wide-band monitor that lets you actually see system problems and trace them to their source.

**Tune in all cable, off-air and FM channels with digital ease and accuracy.** The FS74's exclusive microprocessor controlled, digital PLL tuner lets you tune in all sub-band, mid-band, super-band, hyper-band, VHF, UHF and FM frequencies that range from 5 MHz to 890 MHz. Plus, the FS74 gives you a special AFT that instantly locks into the exact carrier frequency, then tells you on the LCD display if that channel is off-set in frequency to 1 kHz resolution. Cable shifts are no problem, simply select between standard FCC operation or HRC and ICC offset. The microprocessor does the rest for you automatically.

**Super sensitivity brings in the weakest signals with 100% automatic attenuators.** The FS74 gives you a super sensitive 5 microvolt sensitivity (-46 dBmV) on all frequencies that allows you to troubleshoot all the way back to the head-end or receiving antenna. No more switching attenuator inputs or ranges that can

lead to time-consuming mistakes. The RF input is fully autoranged, simply connect the cable to the input, and the FS74's microprocessor selects the proper attenuator range for you automatically, so you can measure signals instantly, from -46 dBmV to +60 dBmV.

**Microprocessor control makes all performance tests fast and simple.** By using the latest microprocessor technology, time consuming tests are automated and streamlined for quick and dependable results. All tests can be made on an in-use channel without removing or decreasing modulation, or adding special carriers. A patented signal-to-noise test automatically compares the signal level to the actual in-channel noise level. No more tuning to a "dead spot" or unused channels for a reference. Making audio-to-video level tests are simple, the FS74 automatically tunes in both the video and audio carriers and reads out the corresponding difference automatically and on any channel. You don't have to tune each carrier individually, or make calculations. Hum tests are made directly on any in-use channel without removing modulation, a Sencore exclusive.

**Exclusive built-in wide band monitor gives you picture quality checks anytime, anywhere.** If you've ever hunted down picture ghosts or interferences, you'll appreciate the value of this exclusive FS74 feature. The wideband monitor is an integral part of the FS74. That means no additional cables or cords to connect or TVs to haul around. Just turn on the monitor and view any of the television channels in full detail on the CRT monitor. Its full 4 MHz bandwidth means it will help

you isolate problems that affect large screen receivers, but which go unnoticed on portable televisions.

**Built-in autoranging AC/DC voltmeter and ohmmeter means you'll never be caught short.** Your troubleshooting capabilities are rounded out with AC and DC voltage measurements and a special low resistance ohmmeter right at your finger tips. Measure up to 200 volts AC or DC right through the RF input, or measure AC and DC volts or ohms through the external DVM input.

We guarantee the FS74 will cut your RF Distribution System servicing time, or your money back. Discover the FS74 and all its exclusive features, call **1-800-843-3338** and locate system problems faster than you imagined possible.



**Call WATS Free 1-800-843-3338**

**New**

Automatic Microprocessor  
Controlled For Accurate Error Free  
Cap/Coil Analysis



### LC77 AUTO-Z Automatic Capacitor And Inductor Analyzer \$1895 Patented

On GSA Contract



**LC77 AUTO-Z - The Only Dynamic, Portable, Automatic Capacitor/Inductor Analyzer Guaranteed To Help You Quickly Find Any Defective Capacitor Or Inductor That Other Testers Miss, Anywhere, Without Calculations, Look-up Tables, Or Error.**

**Discover the Z Standard that eliminates the guesswork, interpretation and calculation errors in capacitor and inductor testing.** The LC77 AUTO-Z makes testing any capacitor or coil simple, without having to make calculations or pull out look-up charts to determine if the component is within standards. Its advanced digital technology completely analyzes capacitors and inductors for all the ways they can fail. You simply enter the parameters: value with the tolerance you require, the rated voltage of the device and the type of device. The LC77 AUTO-Z takes over from there and compares the actual readings to standards tables stored in its memory, and simply displays if that component is good or bad based on EIA and industry standards. It's like having a Standards Engineer with you all the time.

**Thoroughly and automatically analyze any capacitor from 1 pF to a massive 20 farads. Only the LC77 AUTO-Z allows you to test today's high tech components.** The AUTO-Z tests capacitors for every parameter in which a capacitor can fail. It reads out the capacitor's value and whether it's good or bad based on the tolerances that you want. Plus the LC77 gives tests no one else gives you. Tests for leakage, dielectric absorption and ESR, and it tells you if the cap is good or bad based on EIA and industry standards.

**Finally, test inductors reliably from .1 uH to 20 henrys.** The LC77 AUTO-Z tests inductors dynamically so you have a way to finally track down tough-to-find coil problems. The LC77 automatically reads out the inductor's value, and if it is good or bad based on your tolerances. It also gives you an automatic ringing test

that allows you to test down to one shorted turn, and find inductor problems that other testers miss.

**Portability allows you to take the AUTO-Z anywhere you need to troubleshoot.** The full power and potential of the LC77 AUTO-Z is packed into a light-weight, portable (battery and AC) package. The AUTO-Z is designed with CMOS logic, LCD technology and automatic shut-off feature for low-power consumption (the LC77 operates over eight hours on one battery charge). Take the LC77 AUTO-Z wherever you check capacitors and inductors - in the field, shop or factory.

**IEEE488 compatible for automated testing and data collection.** Use Sencore's optional IB72 to control the AUTO-Z over the IEEE488 Bus for data collecting, incoming inspection, and quality assurance tests.

### SCR250 SCR and Triac Test Accessory™

**New**

**Now You Can Test SCRs And Triacs With Any Sencore Z Meter.**

- Test All SCRs and Triacs
- Exclusive Dynamic Leakage Test
- New Sensitive Gate Test

**Dynamically Test All SCRs And Triacs For Leakage And Turn-on With 100% Reliability.**

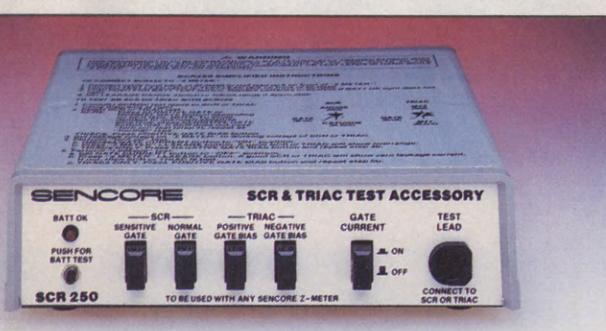
**Tests all SCRs and triacs.** The SCR250 tests all SCRs and triacs in both directions. It's completely isolated and the controlled internal battery supply protects sensitive gates while guaranteeing turn-on of the most demanding high current industrial SCRs and triacs. No more missing those triacs that check good in one

direction but are leaky in the other.

**Exclusive dynamic leakage test.** SCRs and triacs are dynamically tested at their full working voltage. You'll never again get caught guessing whether or not an SCR or triac is good.

- Easy To Use, No Setup Or Specifications Needed
- Tests Industrial And Protected Gate SCRs And Triacs, Too

**SCR250**  
**SCR And Triac Test Accessory**  
**\$168**



**Easy to use.** The SCR250 was designed with your time in mind, to allow you to easily test SCRs and triacs. There is no complicated setup, or need to look up specifications. Just select SCR or triac and gate configuration and push the button to test. The SCR250 mounts on any Z Meter with Velcro® strips.

## LC76 PORTA-Z™ Capacitor And Inductor Analyzer

- Rugged All Steel Construction
- LCD Display
- Full Day's Operation On Battery; Auto Shut Off After 30 Minutes
- Double Patented Inductor Analyzer
- Patented Capacitor Analyzer With Dynamic Leakage Tests To 1,000 Volts
- Tests L/C Components, SCRs, Triacs, Hi-Voltage Diodes, Cables And Transmission Lines
- NBS Traceable Accuracy; Capacitors 1.0%, Inductors 2.0%
- Special Test: Transmission Line Distance To Open Or Short

New

On GSA Contract

### LC76 PORTA-Z Portable Capacitor And Inductor Analyzer \$1395 Patented



### The LC76 Brings Portability To Cap And Coil Testing - Get Lab Accuracy Anytime, Anywhere.

**Increase your troubleshooting confidence anywhere, on the bench or in the field.** The LC76 PORTA-Z cap/coil analyzer gives you the time tested and proven Z tests with portability. With the LC76 PORTA-Z you get the know-how and expertise gained from Sencore's years of Z Meter experience. You also get NBS traceable accuracy on the bench or in the field.

**Locate capacitor and inductor failures that all other testers can't find.** Measure capacitors from 1pF to 200,000 uF and test them at voltages up to 1,000 volts. Test for value, leakage, dielectric absorption and

ESR. Test inductance values from 1 uH to 10 H. Test the effective quality of coils, yokes and flybacks with Sencore's patented ringing test.

**Exclusive high potential testing to 1000 volts in a portable tester.** Isolate leakage problems fast with an unheard of portable 1,000 volts. A new power circuit gives you all the power you need, yet still gives you 9 hours of portability on one battery charge.

**The LC76 gives you true versatility in capacitor and inductor analyzing.** The Sencore Z-METER family has

been the standard by which capacitor/inductor analyzers are measured. No other equipment performs total dynamic tests. Now with the LC76, you get the Z-METER tests anywhere, anytime and anywhere.

**Locate faults in transmission lines or buried cable.** The LC76's portability allows you to track down cable breaks in remote areas. Simply measure capacitance of an open line (or inductance of a shorted one), and calculate the distance to the fault.

## LC75 Z METER 2™ Capacitor And Inductor Analyzer

New

On GSA Contract  
NSN 6625-01-118-8016

### LC75 Z METER 2 \$995 Exclusive Triple Patented Plus One Patent Applied For.

### The First Tester Designed To Solve New High Tech Cap And Coil Challenges.

**Solve capacitor challenges accurately and quickly.** The LC75 gives you proven tests; value from 1 pF to 200,000 uF, leakage with applied voltage up to 600 volts, dielectric absorption, and ESR test. Find the other 75% of defective capacitors that "value only" testers miss. The LC75 is guaranteed to cut your troubleshooting time and boost your troubleshooting confidence.

**Test inductors in or out of circuit with the time proven Z-Meter inductance tests.** The LC75's double patented inductor tests check for true inductor value, and tests

the effective quality of the coil with a special ringing test, in or out of circuit. Find shorted turns and problems that "value only" testers can't find. The patented ringing test even finds just one shorted turn. Just push the button and read inductor value from 1uH to 10H and read the quality of the inductor with 100% reliability.

**Check for insulation breakdown and troublesome leakage paths in areas where isolation is critical.** The LC75 is a hi-potential leakage tester for testing switches, PC boards, connectors and contacts. Read

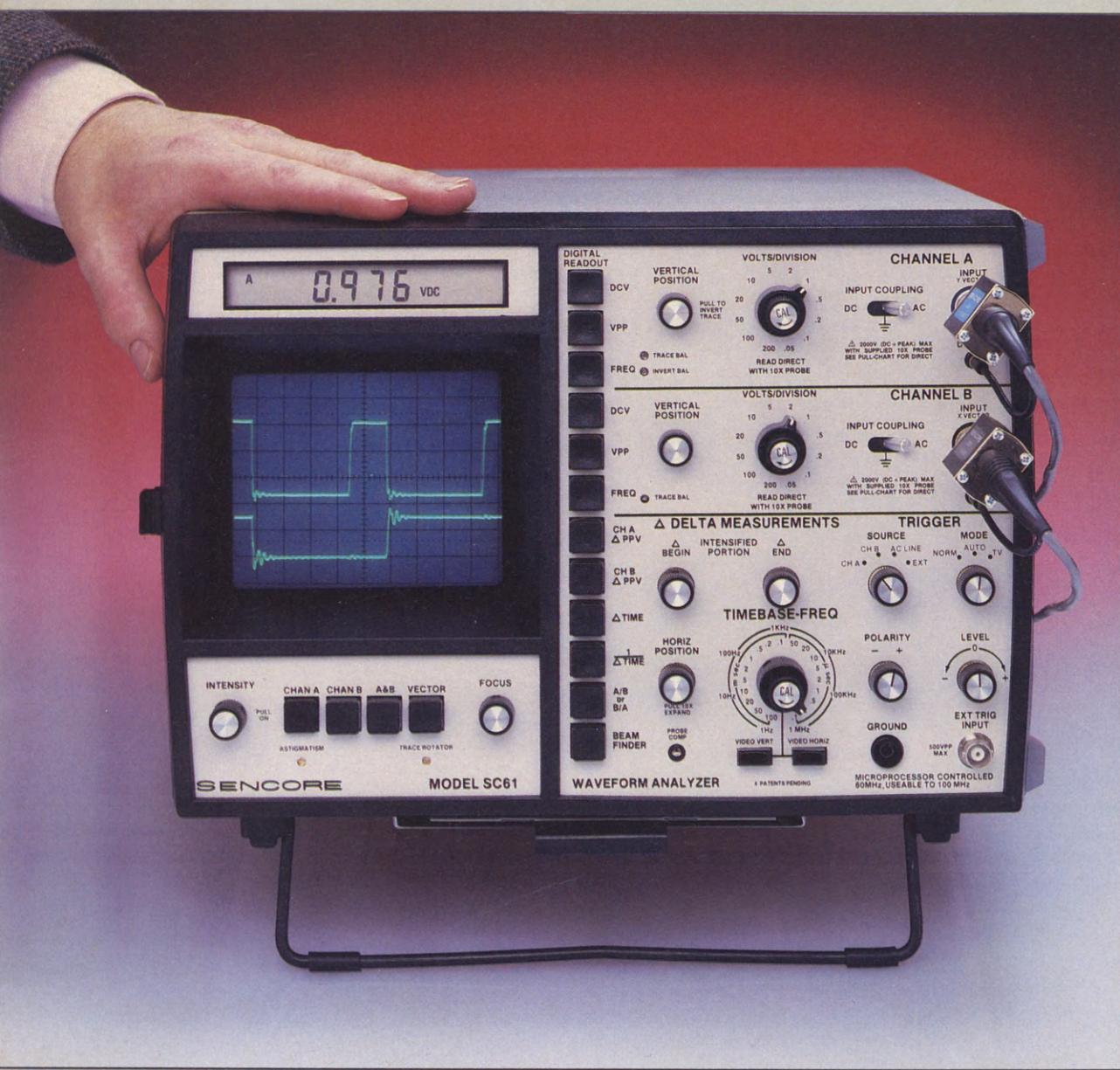


leakage as low as one microamp at voltages as high as 600 volts.

**Eliminate costly errors.** The LC75 allows you to locate potential problems that otherwise could go undetected, and cost you money down the line. The LC75 is autoranged, so it's easy to use, and has a handy pull chart to guide you in your testing. For your safety, and to keep from damaging sensitive components, the LC75 flashes a warning when 50 volts or more is applied to a device. Capacitors are automatically discharged when the leakage button is released.

Call WATS Free 1-800-843-3338

# SC61 Waveform Analyzer™ 60 MHz (usable to 100 MHz) Dual Trace Waveform Analyzer



## Improve Your Troubleshooting Efficiency To Cut Your Troubleshooting Time And Boost Your Service Profits.

At first glance the SC61 Waveform Analyzer may look like an ordinary conventional oscilloscope: high performance, dual trace, 60 MHz bandwidth (usable to 100 MHz). But when you pick up the probe and connect to a test point, that's when the SC61's special ECL sync circuits and auto-tracking digital readout begin working for you to save you valuable time and effort.

There are other scopes on the market that have digital readouts, but none of them have completely eliminated graticule counting, interpretation and extra lead hook ups. The SC61 was designed to integrate the features of a high performance scope with exclusive sync circuits and digital display to give you automatic, rock solid measurements through one probe. You simply hook up the probe to the circuit, then view the locked in waveform on the CRT. To read DC voltage, peak-to-peak voltage, and frequency of the waveform you simply push a button and read it directly on the auto-ranged LCD digital display — all through one probe, and without interpretation. It obsoletes other scopes like the calculator obsoleted the slide rule.

The SC61 Waveform Analyzer also gives you exclusive DELTA functions that allow you to analyze any part of a waveform in just seconds. Measure peak amplitude of part of a waveform, time of an event, or frequency of part of the waveform. Now you can easily locate the source of ripple on DC supplies, catch the frequency of a small glitch, or check the duty cycle on a digital waveform. Just lock in the waveform on the CRT, and adjust the DELTA BEGIN and DELTA END to intensify

the portion of the waveform you need to analyze. Then simply push a button and read out the corresponding peak-to-peak voltage, time or frequency. It makes troubleshooting defective waveforms easy, so you can locate the problem circuit quickly.

**It's high performance.** The SC61 gives you 60 MHz usable to 100 MHz bandwidth to troubleshoot even the latest digital circuits. The SC61 also gives you dual delayed signal trace so you can see the leading edge of the waveform on both channels. You can also add, subtract or view both channels separately.

**It's digitally accurate.** The SC61 Waveform Analyzer eliminates inaccurate and frustrating graticule counting. The internal microprocessor monitors the signal that is applied to the CRT, and digitally tracks the important parameters you need. Peak-to-peak volts, DC volts and frequency. You get measurements that are 10 times more accurate than conventional scopes.

**Its waveforms are rock solid.** The SC61 Waveform Analyzer, with its special circuitry, has the ability to lock quickly onto waveforms all the way to 100 MHz. This has been achieved through exclusive ECL (emitter coupled logic) circuits in the front end and noise cancelling differential amplifiers throughout the sync circuits. The SC61 Waveform Analyzer provides "rock solid" sync that allows you more time to troubleshoot, and less time fiddling with the trigger control to lock in a waveform.

## Meet The Triple Patented SC61 Waveform Analyzer

- 60 MHz high performance scope that will put confidence back into your waveform measuring.
- 100% automatic AUTO-TRACKING™ digital read-out of all key waveform parameters at just the push of a button.
- Faster, more accurate, easier than you ever dreamed possible.
- Rock solid sync eliminates frustrating fiddling with complicated controls.
- 4 times the measuring capability of any conventional scope for true peace of mind.
- Plus many extra, exclusive high performance features that will save you time.

## SC61 Waveform Analyzer \$3295 Patented

On GSA Contract  
NSN 6625-01-169-2318



*"I've used about every scope on the market at one time or another and I've got to say the SC61 is the easiest and fastest of them all."*

**Kerry L. Haught**  
Audio/Visual and Video Repair  
Mentor, OH

**It safely handles 4 times the signal level of any conventional scope.** Most conventional scopes are able to handle only up to 600 volts on their input circuitry. The SC61, however, provides you with 5mV to 2000 volts (protected to 3000 volts) measuring ability to give you the extra versatility you need. Perform high voltage measurements without worrying about overloading the front end and causing you additional expense and downtime.

**Plus many extra high performance features.** Post deflection, high intensity, blue phosphor 8 X 10 cm CRT provides easy-to-view trace, even under high ambient lighting conditions. • IEEE488 Bus Compatible. • Push button X-Y vector display with 4 MHz response for accurate phase comparisons. • Z-Axis input. • Beam finder. • TV Vertical and TV Horizontal video preset positions with sync separators.



# CR70 "BEAM BUILDER"™

Universal CRT Analyzer and Restorer

**For The First Time Ever . . . Test Every CRT On The Market—Now And In The Future—Plus Restore 90% Of All Weak Or Shorted CRTs . . . Or Your Money Back. (Includes Color/B & W TVs, Scopes, Computer Displays, Camera Tubes And More.)**

- Guaranteed To Test Every CRT (Old Or New)
- Guaranteed Dynamic Tests You Can Trust
- Guaranteed To Safely Restore 9 Out Of 10 Weak Or Shorted CRTs
- Guaranteed To Be Totally Protected From Damage From Charged CRTs

## CR70 "BEAM BUILDER" Universal CRT Analyzer and Restorer

**\$1295 Patented**

NSN 6625-01-187-4395

**"The CR70 is a great instrument and has saved us money on camera tubes."**

**Eddie H. Sills  
Chief Engineer (Maintenance)  
Roswell, New Mexico**

**Stop wasting valuable time and profits by replacing CRTs.** Today's electronics in the latest TVs are getting more and more reliable, but there is still one area of the TV that is guaranteed to fail, the CRT. However, most CRTs that do fail can be successfully restored with a reliable restoring system. The CR70 gives you the most reliable system anywhere that allows you to restore tubes that you would otherwise replace. The CR70 is a breakthrough in CRT restoration, here's why . . .

**Test every CRT on the market.** The CR70's unique selectable switches, universal adaptor and its wide restoration current range allows you to test every type of CRT in use today.

- All B & W and Color Video CRTs
- Projection CRTs
- Computer Display CRTs
- Closed Circuit Video CRTs
- Camera pickup tubes - broadcast, industrial and surveillance
- Even scope, radar and other industrial CRTs

### You'll never have to buy another socket again.

There are thousands of different types of CRTs that are being used today, and with them comes a lot of different socket configurations. However, most of the CRTs use one of ten basic designs in their socket basins. The pins might change position, but the general design stays the same. The CR70 takes advantage of this fact by allowing you to select the pin configuration with switches, rather than having to buy a new socket. Simply connect the socket that fits the neck, and select the grids, filaments and cathode with the selectable switches. If you do run across an "oddball" CRT, the CR70 gives you a universal adaptor that allows you to connect and test those non-standard CRTs.

**Dynamic tests you can trust.** The CR70 tests the CRT over its entire operating range, from black (cutoff) to white. It's the only tester that does. The CR70 tests emission as "true beam current" (current that passes through the control grid to the screen grid). Plus, its exclusive cutoff test accurately identifies CRT problems related to bad contrast that other testers miss. A patented color tracking test gives a direct good/bad

comparison of all three guns of a color CRT or all three CRTs of a projection system to confirm they will balance properly for any color or B & W picture. The CR70 also tests for shorted elements.

**Restore CRTs safely and effectively.** Many technicians know what a conventional CRT rejuvenator can do to a CRT. Most of the time it's "push the button and pray." The CR70's exclusive controlled current system means you never again have to worry about losing a CRT again by zapping it too hard. The CR70 is guaranteed to restore 9 out of 10 weak or shorted CRTs. This saves you thousands of dollars by extending the life of the CRT compared to replacing the CRT, or by restoring a CRT that is no longer available. Only the CR70's progressive restoration gives you this ability.

**Full protection from overload damage.** Many CRT testers are damaged by the high voltages left on the CRT. The CR70 is fully protected, however, to eliminate the possibility of this with special MOVs (metal oxide varistors).



## CG25 Little Huey™ Portable, Digital Color Bar Generator

### Rock-Solid Patterns In A Pocket Size Generator

- Push Button Ease—Caddy Size
- Jitter Free Patterns
- Battery Saving Shutoff
- Test Leads Built In

**CG25 Little Huey \$198**

**Rock-solid digital patterns:** Just push the buttons for jitter-free standard color bars, horizontal and vertical lines, crosshatch, and white dot patterns.

**Built rugged for field use:** Lasts and lasts on the road with tough acrylic case.

**Big generator features:** Dot size, color level, and RF channel controls just like the deluxe generators.

**Call WATS Free 1-800-843-3338**

# FC71 Portable 10 Hz To 1 GHz Frequency Counter™



## FC71 Frequency Counter—The Only Portable Counter Especially Designed With An Exclusive Microprocessor Controlled Timebase To Measure 10 Hz To 1 GHz To 0.5 PPM Accuracy In High RF Environments

The only truly portable 1 GHz counter that makes every reading better than FCC requirements. The FC71 uses a unique, new, microprocessor-controlled timebase. This patented counter provides (0.5 ppm/yr aging) from 10 Hz to 1 GHz. With the 8 1/2 digit LCD display, you get superior accuracy on the high end while allowing .01 Hz resolution for low end and audio work.

Since there is no power robbing oven, the FC71 gives nine hours of continuous operation. Take it wherever it's needed: broadcast towers for FCC documentation, repeater sites, for troubleshooting or airplane cockpits for avionics tests.

The most sensitive frequency counter available allows you to count signals other counters miss. The FC71's 5 mV input sensitivity lets you count signals in more circuits than with any other counter - without external amplifiers. It will even measure the output of RF

generators and communications monitors that can't be tested with other counters.

**The highest stability available lets you count the toughest signals.** The FC71 is guaranteed to be the most stable counter you can buy. It's uniquely designed input circuits allow you to count signals that are otherwise unmeasurable. Signals like AM or FM, digital signals with ringing, or signals with noise. The FC71's stability means you never have to guess at frequencies again.

**Fully RF shielded so you can measure anywhere, even in high RF fields.** With most counters, you cannot make measurements near a broadcast or 2-way transmitter because the counter picks up the transmitter signal through the case. The FC71's double shielding lets you measure signals in RF fields that are impossible to measure with other counters.

- 10 Hz - 1 GHz Portable Frequency Counter
- Five Times More Accurate Than FCC Requirements Even On The Toughest Job; 0.5 Parts Per Million
- Exclusive Microprocessor Time Base For Super Stability From -12°F to 122°F
- Measures All Signals, Even Complex And Noisy Signals, With Exclusive Sensitivity Control
- Super 5 mV Average Sensitivity Over Full Range
- Automatic Crystal Check Tests The Fundamental Frequency Of Any Crystal
- Frequency Ratio Compares Two Frequencies And Displays The Ratio Directly
- Double Shielded For Interference Free Frequency Measurements Anywhere
- Automatic Readings When Used With IEEE 488 Computer Interface

## FC71 Portable 10 Hz To 1 GHz Frequency Counter \$1295 Patented

NSN 6625-01-076-2695



**Additional tests make the FC71 more than a counter.** An exclusive frequency-ratio test simplifies troubleshooting in digital and RF multiplier and divide circuits. Simply measure the input, press the frequency store button, measure the output, and push the ratio read button to find the exact ratio. The FC71 also has a unique crystal test to check any crystal at its fundamental operating frequency to eliminate guesswork in oscillator repairs.

**IEEE 488 instrument bus interface automates the FC71 for extended tests.** Sencore's optional universal IEEE interface, the IB72, allows you to use the FC71 with a computer for automated testing and data collection. Perform system stability tests over long periods of time, or document frequencies in quality control tests.

## TF46 Portable Super Cricket Portable Transistor/FET Tester



### Test Any Transistor Or FET With 99% Reliability In Less Than 15 Seconds—In Or Out Of Circuit

- Needs No Set-up Book Or Instructions
- Patented In-Circuit "go/no-go" Transistor/FET Test
- Now More Automatic Than Ever, Identifies Transistor Leads
- Portable Operation With Auto Shut Off To Save Your Batteries.
- Tests All Possible Leakage Paths
- Dynamic Gain Test

NSN 6625-01-058-9564

### TF46 Portable Super Cricket Portable Transistor/FET Tester \$495 Patented

**Instantly test any transistor or FET without set-up books.** The TF46 is the latest in a long line of "cricket" testers that gives you a patented "good" or "bad" test in or out of circuit. The TF46 is completely automatic, simply hook up the three leads in any configuration, and the TF46 tells you if the device is good or bad with an audible chirp, and on the meter. It also identifies the transistor's base, emitter and collector, or the FET's gate, drain and source.

**Test for gain at the push of a button to match transistors and speed troubleshooting.** The TF46 also allows you to test for leakage on transistors that show good gain, but have leaky collector-to-base or collector-to-emitter junction. Plus it has a diode test too, for more versatility.

**Trademarks of Sencore, Inc.:** Little Huey, Super Cricket, MICRORANGER®, POWERITE®, Waveform Analyzer, AUTOTRACKING, BEAM BUILDER, CHANNELIZER JR., CHANNELIZER SR., PORTA-Z, AUTO-Z.

**Pricing Note:** All prices shown are U.S. dollars. Canada must add applicable Duty, Freight, and F.S.T. Prices and specifications subject to change without notice.

## Avoid Embarrassment And Risk—Know Beyond A Doubt That Your AC Power (And The Equipment You Service) Is Right And Safe

The PR57 "POWERITE" lets you know your AC power is right and includes a variable isolated 470 Watt power transformer to isolate your AC line and vary the output voltage from 0 to 150 volts. You'll monitor voltage, current, and wattage to prove that the equipment under test isn't drawing too much current at any voltage setting.

**Variable output supply is isolated for your protection.** The "POWERITE" 470 Watt AC variable output transformer provides a continuously variable output voltage from 0 to 150 volts; a must for troubleshooting shutdown circuits. It protects you and your test equipment from shocking overloads by isolating you (and the equipment under test) from the AC line.

**Solve challenging shutdown problems and eliminate callbacks.** Lower the line voltage to solve tough shutdown problems. Raise the line voltage to sweat out intermittents or sensitive parts. Test every

### Five Ways You Can Make Sure Your Power Is Right With A "POWERITE"®

- It's an isolation transformer.
- It's a variable AC supply.
- It's a power line monitor.
- It's an amp/watt meter.
- It's a safety leakage tester.

### PR57 "POWERITE"® \$495 Patented

NSN 6625-01-124-6296

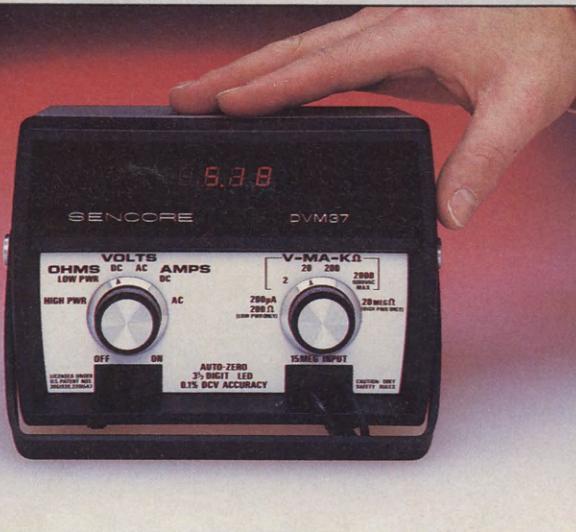


set at high or low line voltage to avoid embarrassing callbacks. Identify AC line related problems like picture width, sync, and intermittents in the customer's home or test in the shop at their line voltage.

**Safety leakage test means safe repairs and additional profits.** Safety checks for current leakage are

easy with the PR57's patented tests. Leakage tests are now required from all manufacturers, and you decrease your liability and increase your profits when you perform this test. Since it's a service you offer, you can charge \$3 - \$5 to perform the test, and make a profit on a quick, but vital test.

## DVM37 3 1/2 Digit, 0.1% Bench/Portable Digital Multimeter™



### For Confidence And Success In Troubleshooting, You Need A DVM That Holds Lab Accuracy Under The Most Rugged Conditions.

**One super rugged digital voltmeter for every use.** If you like to use one meter and use it everywhere and anywhere, you'll want the super, reliable DVM37. You can drop it, kick it, carry it by the test leads, and it will keep right on operating at lab accuracy.

**Fully protected inside.** Unheard of 8 kV transient protection on every function and range, including ohms means unmatched internal protection.

**0.1% DCV accuracy into 15 Megohm input.** 15 Megohm input impedance means 50% less loading than other meters with 10 Megohm input impedance. Therefore, you get 50% greater accuracy than other 0.1% DVMs.

- Automatic .1% accurate DVM for bench or field for measurements you can count on.
- 15 Megohm input impedance for least loading and error, especially in high impedance circuits.
- Protected inside, too, better than any other DVM on the market, to 2 kV DC with 8 kV transient protection and to 10 kV with TP212 probe.
- An Indestructible DVM For Both Bench And Field

### DVM37 3 1/2 Digit, 0.1% Bench/Portable Digital Voltmeter \$395

## DVM56A "MICRORANGER"® Digital Voltmeter



### DVM56A: The Most Versatile Time Saving Bench DVM You Will Ever Own.

- 100% Automatic, designed to save you time, simply touch and test and MICRORANGER® does the rest.
- Lab Accuracy - .075% 4 1/2 digit with 15 Megohm Input Impedance
- Versatile - 16 Microprocessor Controlled Measuring Ranges
- Tough - Fully protected to 7.5 kV overload and RF interference free.

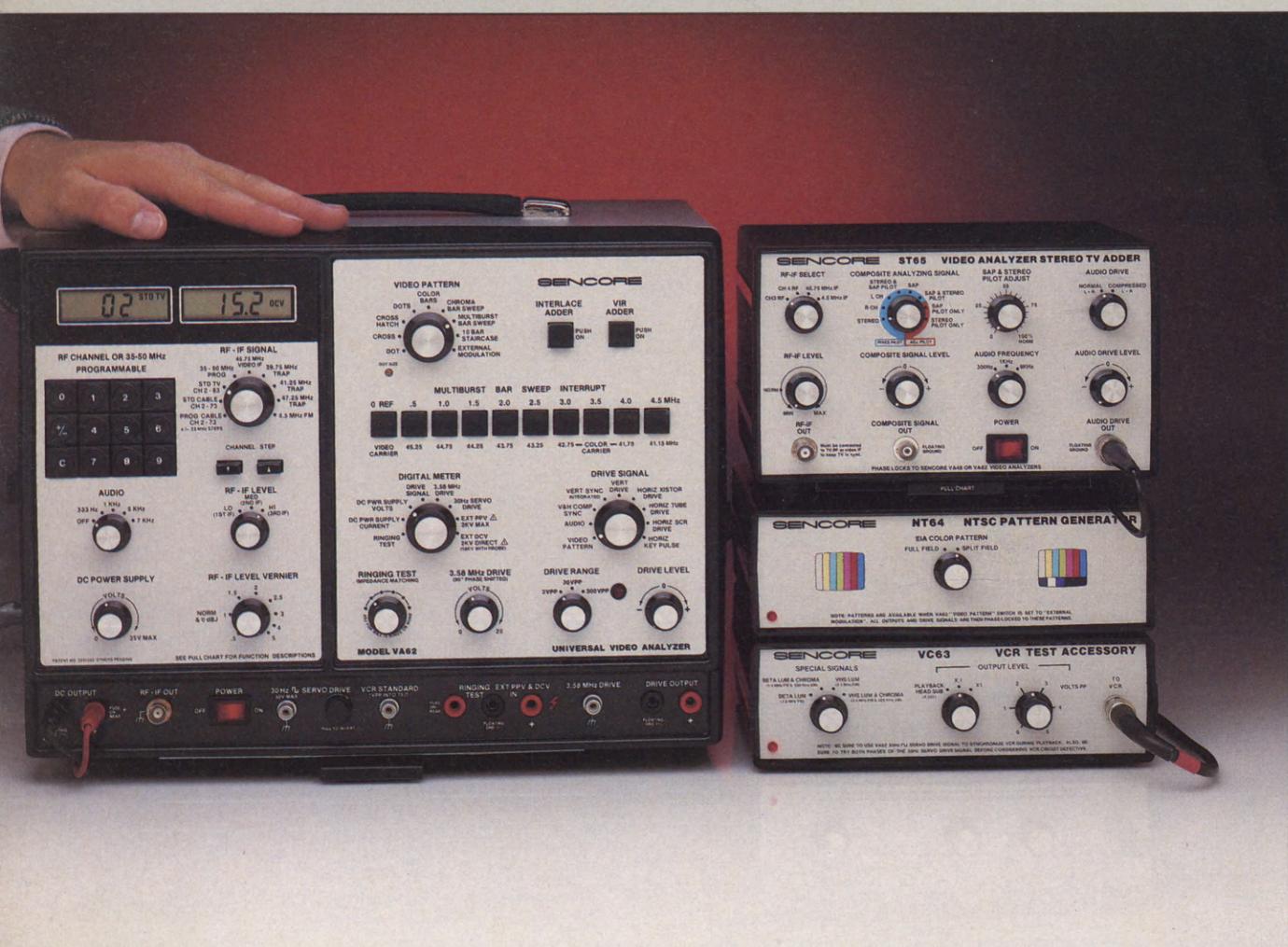
### DVM56A "MICRORANGER"® Digital Voltmeter \$995 Patented

**The most versatile meter on the market.** If you want the best, then the DVM56A MICRORANGER is the meter for you. The DVM56A gives you all the tests you'd ever want to perform with a DVM. The internal microprocessor automatically ranges the MICRORANGER, and gives you these exclusive tests:

- AC and DC current up to 20 amps with the optional CS233 current shunt
- High and low power resistance
- .075% accurate DC to 10 kV
- AC Volts peak-to-peak
- AC Volts true RMS
- AC Volts average RMS
- dBm and programmable dB

**Super accuracy and error free readings every time.** 4 1/2 digit readout with .075% DCV accuracy. 15 Megohm input impedance means less loading and more accurate tests. Microprocessor control means no errors.

# VA62 Video Analyzing Package . . . Obsolete Proof



**Isolate Video Troubles In Half The Time  
With The Only Universal Video Analyzer.**

- Identify tuner problems with all-channel, VHF, and cable RF generator.
- Pinpoint IF troubles with modulated troubleshooting signal and exclusive programmable IF generator.
- Isolate any trouble with patented video and standard color-bar patterns.
- Find defective stages, without disconnecting parts, with exclusive phase-locked drive signals.
- Test yokes and flybacks plus measure signal levels with autoranged digital meter.
- It's obsolete proof; update for new technology with exclusive phase-locked accessories.

## VA62 Universal Video Analyzer \$3495 Patented

On GSA Contract  
NSN 6625-01-187-5516

## VC63 VCR Test Accessory \$495

NSN 6625-01-201-2880

## NT64 NTSC Pattern Generator \$495

## ST65 Video Analyzer Stereo TV Adder \$995 Patent Pending

## The Only NTSC Video Servicing System Guaranteed To Cut Your Servicing Time By 54% Or Your Money Back.\*

The VA62 Universal Video Analyzer is the only system that equips you for successful servicing in the expanding video market. It ends expensive parts substitution (especially when working with large-scale ICs) and eliminates embarrassing, costly callbacks by allowing you to quickly, confidently, and dynamically check every repair.

**Eliminate aggravating tuner questions.** The all-channel VA62 gives you the confidence of complete RF testing. The "Standard TV" generator produces every VHF and UHF channel, the "Standard Cable" generator every cable channel and "Programmable Cable" function lets you duplicate any cable carrier shift to test lock in range.

**Dynamically isolate IF troubles quickly and easily.** The VA62 isolates any IF trouble with a fully modulated, crystal referenced 45.75 MHz IF signal, matched to inject into any IF stage. Both video and audio modulation identify any trouble. It's a real troubleshooting confidence builder.

Patented signals let you set IF traps—a must for cable—by simply looking at the CRT. Plus, the VA62 lets you do full IF alignments without confusing cables or complicated adjustments.

**Isolate troubles without disconnecting a single component with VA62 drive signals.** No need to unsolder components because the VA62's output circuits automatically "swamp out" the original signal before injecting the substitute signal. These special signals let you troubleshoot any video or sync stage, as well as vertical or horizontal circuits. Separate drive outputs allow simultaneous injection into the tricky closed-loop servo circuits or color oscillators.

### Digital Meters Add Confidence:

**Ringing Test:** The digital meter makes the VA62 a complete analyzer. Start by testing deflection yokes and flyback transformers, in-or out-of-circuit, with Sencore's reliable (patented) good/bad ringing test.

**Drive Level Monitor:** Internal monitoring measures the true peak-to-peak level of any drive signal to prevent overdriving and to show when feeding into a shorted component.

**Peak-to-peak and DC Meter:** Autoranged external meter includes peak-to-peak and DC to a full 2 kV. Compare peak-to-peak and DC directly to the schematic.

**DC Power Supply:** The 0 to 35 volt DC power supply blocks confusing feedback loops in AGC, AFT, ACC or servo circuits or isolates problems in direct coupled (DC) circuits, such as vertical amplifiers.

**Integrate phase-locked accessories into your video analyzing system to increase your service potential.** The accessory jack and the composite video output let you add new technology as you need it. Phase-locking means the accessory signal returns to full sync when used with the other VA62 signals.

### VC63 VCR Test Accessory:

**Substitute for video heads before replacing them.** The VC63's exclusive "Playback Head Sub" signal lets you substitute for the tiny signal (500 microvolts or less) at the video heads. If video returns you can change the heads with confidence.

**Isolate FM problems quickly.** Inject the VC63's modulated signal into any FM stage. If the monitor shows the video pattern you know all the circuits after your injection point are good.

### NT64 NTSC Pattern Generator:

**Meets manufacturers' requirements.** The NT64 produces the two high quality color bars in the two patterns specified by VCR manufacturers: the "full-field" and the "split-field" pattern.

**Phase-locked to all signals.** Sync and references from the VA62 generate and phase-lock the NT64 pattern to the VA62 troubleshooting signals. This makes the NT64 work just like the VA62's built-in patterns.

### ST65 Video Analyzer Stereo TV Adder:

**Add Profitable MTS TV Analyzing Capability To Your Sencore Video Analyzer.** Add stereo TV capability to your VA62 with the ST65. It adds those special signals you need to service stereo TV and Secondary Audio Programming (SAP). You get RF and IF frequencies plus all the signals needed to perform tests of stereo separation, signal-to-noise, crosstalk, audio, pilot threshold, dbx®, \*, stereo decoders and more.

To cut your servicing time by 54% (or your money back), call today at 1-800-843-3338.

\* Based on a nationwide survey of users who reported an average time savings of 54% compared to their previous test equipment.

## VC63 VCR Test Accessory™

Add The Effectiveness Of Signal Substitution To VCR Circuits.

Find defective heads without expensive substitution in VHS, Beta, and U-Matic VCR formats. Plus, pinpoint defective stages with exclusive substitution signal and troubleshoot color problems with special reference signal.

**VC63 \$495**

## NT64 NTSC Pattern Generator™

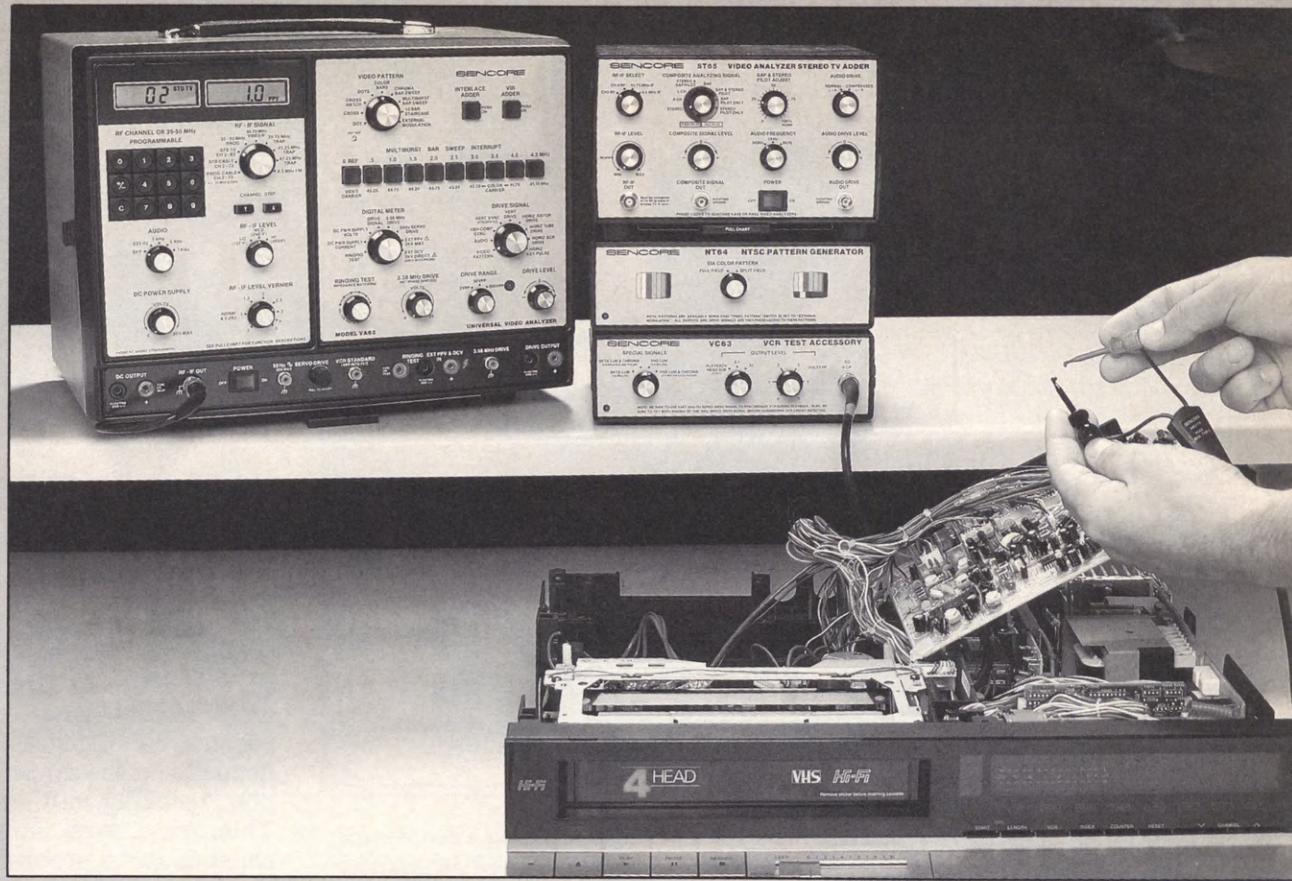
Produces the EIA RS 189 standard full-field and split-field color bar patterns that meet all VCR manufacturer's requirements for a color bar generator. These two patterns are fully phase-locked to all other VA62 signals. The NT64 is one-fifth the cost of competitive stand alone NTSC generators.

**NT64 \$495**

## ST65 Video Analyzer Stereo TV Adder™

Update your VA48 or VA62 Video Analyzer to an integrated Multichannel Television Sound (MTS) Stereo TV analyzing system. The ST65 makes stereo and second audio program (SAP) performance tests on any MTS stereo TV system. Exclusive adjustable RF/IF, COMPOSITE SIGNAL, and AUDIO levels match and isolate troubles in any stage — including the decoder. It's the only tester guaranteed to tie troubles down to any and all stages.

**ST65 Video Analyzer Stereo TV Adder  
\$995 Patent Pending**



## RG67 NTSC Video Monitor Adaptor

Updates Your VA48 or VA62 Video Analyzer — Helps You Expand Into Analog/Digital Monitor Service.

The RG67 provides phase-locked R, G, B, and I signals to drive any NTSC analog or digital monitor. Match any input with selectable signal and sync polarity and adjustable amplitude to 5 VPP. Fast hookup to R, G, B, and I inputs with E-Z HOOK® leads.

**RG67 \$890**



## ST66 Stereo TV Analyzer™

The Only Complete Analyzer For MTS Compatible Stereo TV.

The ST66 is a complete MTS stereo TV and VCR analyzer that provides all of the special signals you need to successfully service MTS stereo TV from the antenna to the speakers with one simple connection. It has exclusive video patterns for total analysis and variable pilots for threshold testing. Plus it's portable—works two hours continuous on one battery charge.

**ST66 Stereo TV Analyzer  
\$1395 Patent Pending**

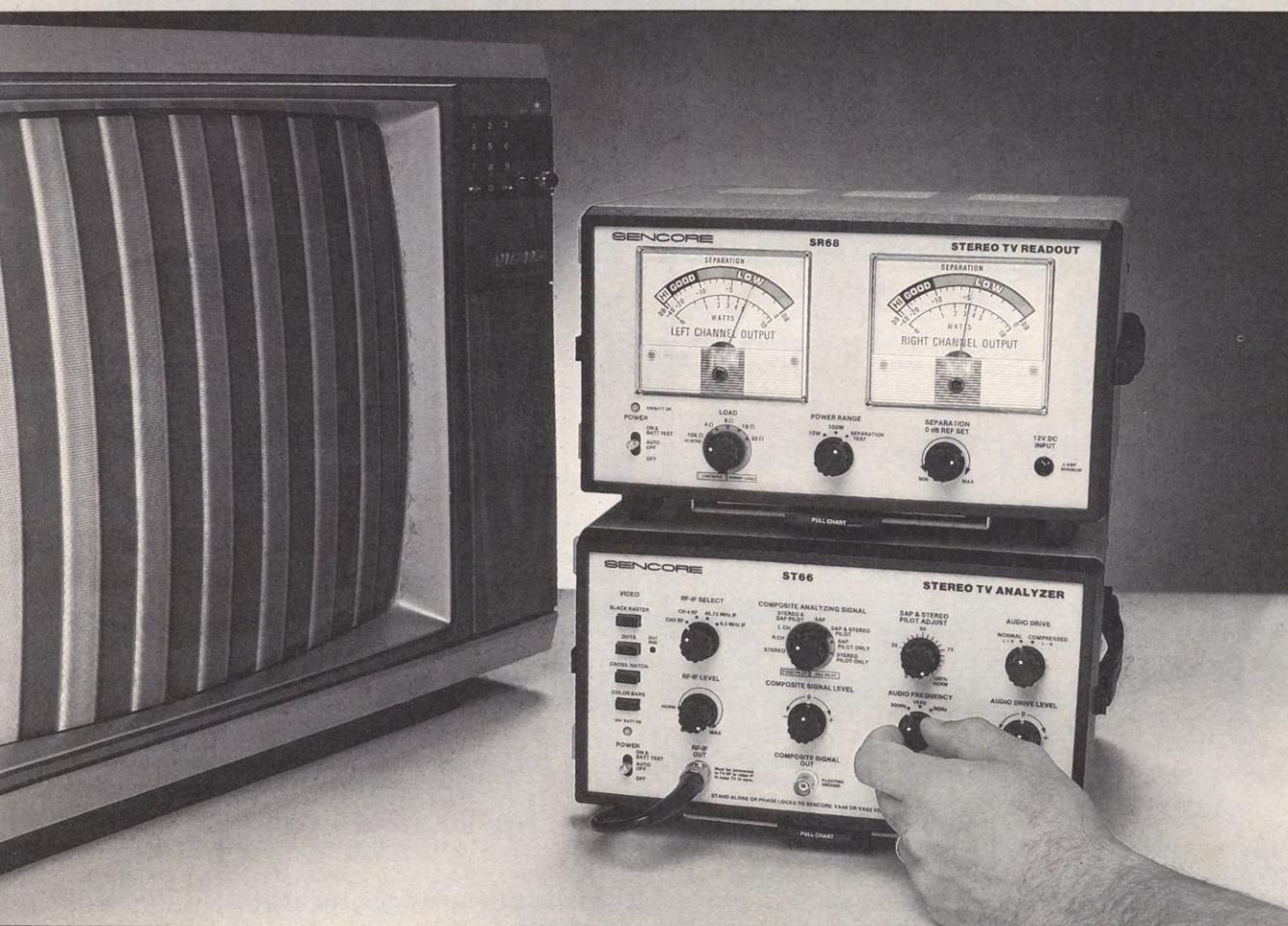
## SR68 Stereo TV Readout™

Dual Meters And Loads To 100 Watts Solve Stereo Servicing Challenges.

Analyze stereo TV Audio Line or speakers in dB or watts. Loads to 100 watts provide dynamic testing and speaker substitution. Automatic channel separation measurements to -40 dB without calculations. The SR68 is battery operated—use in the shop or in the field.

**SR68 Stereo TV Readout  
\$595**

**Call WATS Free 1-800-843-3338**





**Neil R. Graham, CET, is a Lead Technician and Electronics Trainer with Sears Roebuck & Company's High Tech Center at Indianapolis, Indiana.**

**S**ervicing Video Cassette Recorders efficiently and profitably requires a thorough understanding of the workings of the servo system. "Servo" is defined as an electronic system used to maintain constant performance of a machine. Constant performance is the key.

The function of servo control in a VCR is that of maintaining the proper speed and phase relationships between the mechanical devices in the machine, namely the Capstan and Cylinder motors (Figure 1).

### Video Heads, Cylinder RPM, And The TV Frame Rate

From basic television, you will remember that one frame consists of two fields of video information or 525 lines. These frames of information are repeated 30 times each second.

The VCR upper cylinder contains two video head tabs mounted 180 degrees apart. Each head tab records one field of video information each revolution of the cylinder to form a complete frame. The cylinder motor speed is approximately 1800 RPM or 30 RPS. This speed must be maintained even during periods when the tape is not moving around the cylinder.

Remember the television frame frequency of 30 Hz as it will be repeated many times in this discussion.

### Accurate Servo Control Is Only Possible In A Clean, Well Maintained Machine.

The capstan motor is responsible for moving the tape (in record and

normal play) from left to right thru the tape path. In the SP mode, the tape moves at a speed of 33.4 millimeters per second. The tape path includes the following critical components:

- Back tension lever
- Tape path entrance guide
- Full erase head
- Buffer roller
- Cylinder entrance guide
- Video head cylinder
- Cylinder exit guide
- Audio dub erase head
- Audio and CTL heads
- Capstan and pinch roller
- Tape path exit guide

Oxide build-up and tape edge shards deposited on any of the devices in

## Learn How VHS Servo Systems Work, Plus See Why You Should Analyze Servo IC Input/Output Signals Carefully.

by Neil Graham, CET

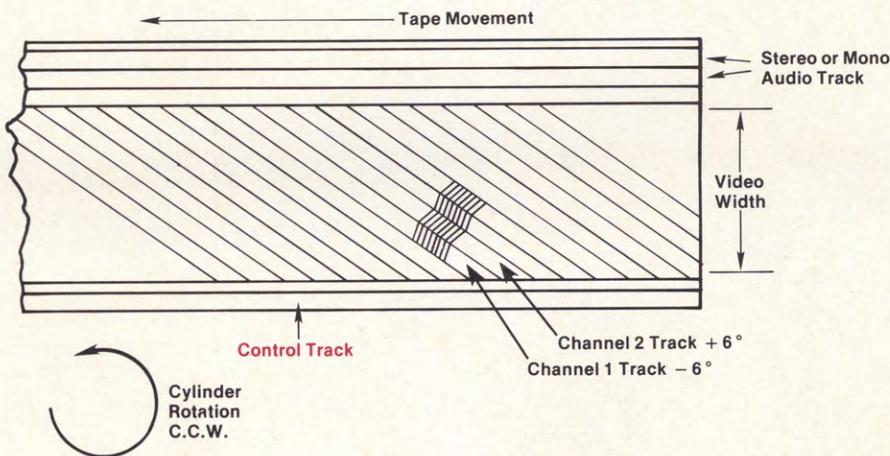
the tape path may cause some degree of improper operation of the VCR.

The upper cylinder is grooved to provide an air cushion for the tape surrounding it. Greatly increased drag results when these grooves become clogged. Large oxide deposits on the upper cylinder cause poor tracking and distorted sound. This may even appear to be a capstan servo problem. Deposits on the audio/CTL head assembly will cause decreased audio or no sound at all, plus the possibility of no CTL pulses reaching the capstan servo circuit.

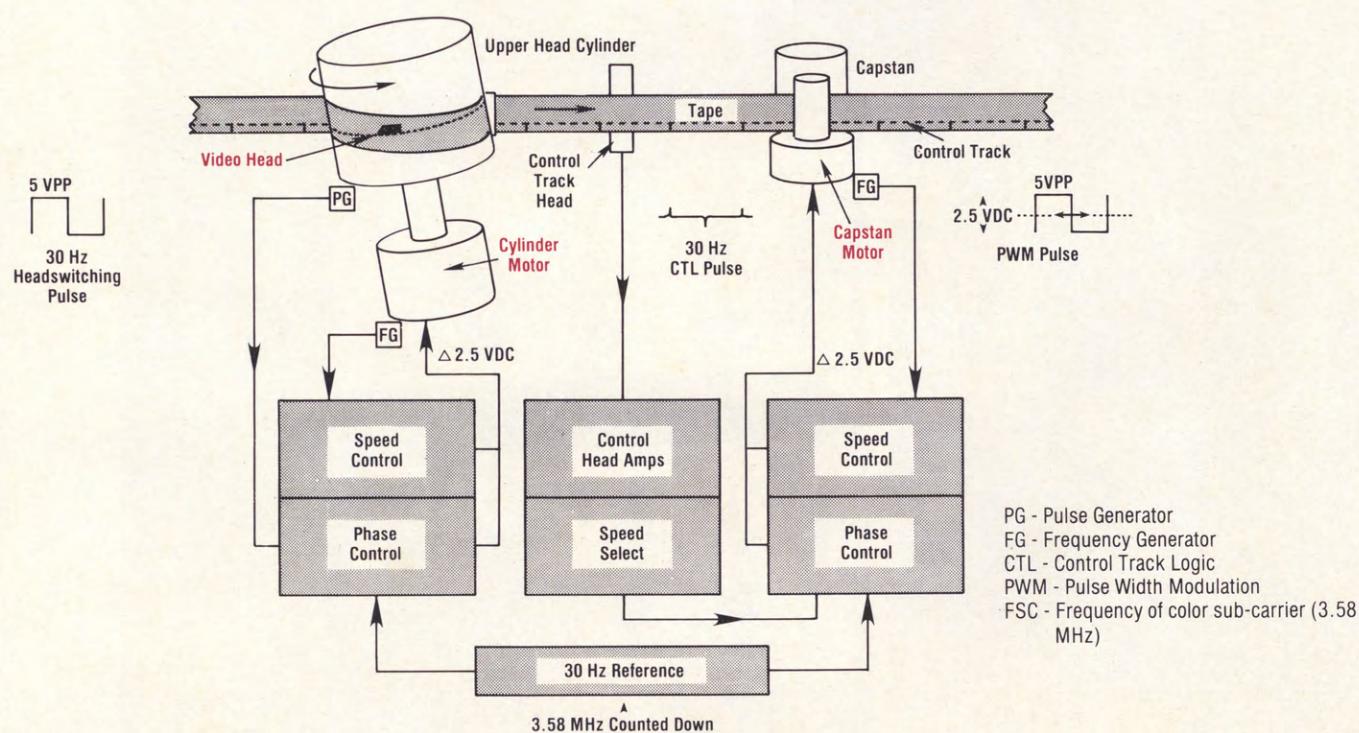
Improper adjustment of the Back Tension Lever (supply reel hub brake) causes poor tape path travel and an inability to properly read audio and CTL track information.

### The Servo System

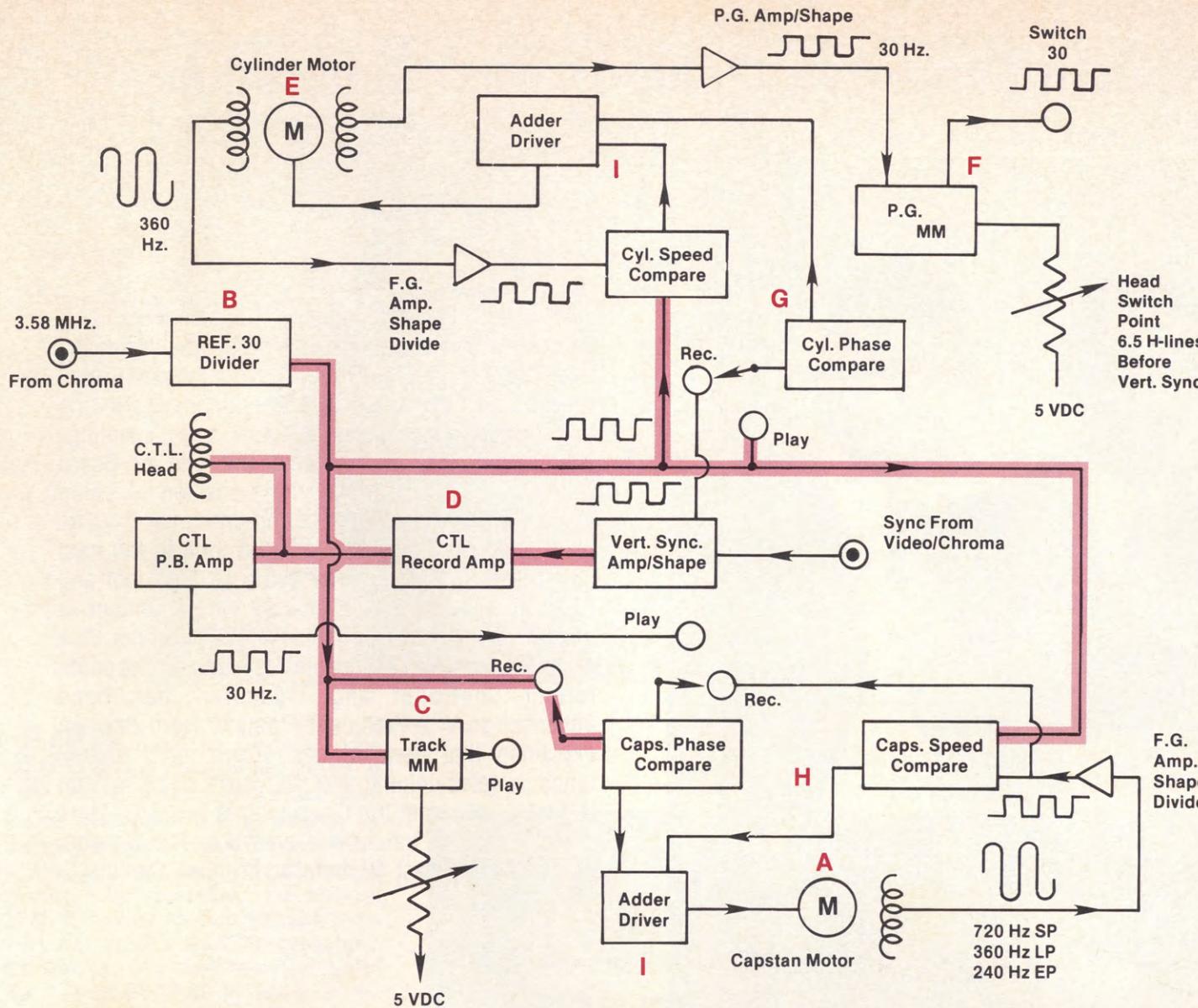
The servo system maintains the proper capstan speed during recording and playback while at the same time, thru phase control, ensures that the head tabs on the video cylinder retrace (during playback) the same tracks each recorded during the record mode (Figure 2).



**Fig. 2: Using control track signals from the tape, the servo system synchronizes the video heads to play back the proper track.**



**Fig. 1: The servo system must maintain the proper speed and phase relationships between the capstan and cylinder motors. Oxide buildup on mechanical parts in the tape path cause improper operation.**



**Fig. 3: VCR servo circuits need a stable 30 Hz signal source as a reference. During record, vertical sync is divided to 30 Hz to feed the control amps (D) and the cylinder phase control (G). During playback, 3.58 MHz from the color circuits (B) is divided down to 30 Hz.**

Each video head tab has its gap azimuth set at 6 degrees. One is at plus 6 degrees while the other is at minus 6 degrees. If the video track which was recorded by the plus 6 degree head is played back by the head which is at minus 6 degrees, the result will be noise instead of the desired video information.

Speed thru the tape path must be kept constant in spite of increases or decreases in drag caused by dirty surfaces and varying back tension. The motors which operate both the cylinder and the capstan are controlled in speed and phase. Speed control takes care of large rotational changes while phase control takes care of the small or fine adjustment.

The drive to each motor is the result of mixing or adding the speed and phase correction signals from the servo circuit.

### Servo Signals

Let's see what signals are used to control the speed of the capstan and cylinder motors.

#### Capstan Frequency Generator (FG) Pulse

*Editor's note: Except for the 3.58 MHz and 30 Hz signals, all other servo frequencies may vary from one make or model of VCR to the next. The examples Neil provides are typical for VHS machines.*

The capstan motor (Figure 3-A), either by toothed magnetic elements (one fixed, the other moving within it), Hall effect devices or fixed coils located near the outside diameter of the motor's magnetic flywheel, generates FG pulses of a certain frequency determined by the flywheel speed (720 Hz in SP, 360 Hz in LP, or 240 Hz in the EP speed).

*Note: These Frequency Generator pulses are used to measure and maintain correct capstan operating speed in both record and playback by comparison with the divided 3.58 MHz reference (Figure 3-B).*

The result of this comparison is fed to the motor drive circuit as the speed error signal.

#### Capstan Speed And Phase Control

Capstan phase control is accomplished during the recording mode by comparing a 30 Hz reference signal, counted down from 3.58 MHz coming from the video/chroma section of the machine, with (in the SP speed) a divided sample of the 720 Hz capstan FG signal (720 Hz divided by 24 equals 30 Hz). The result of this comparison becomes the phase error signal used to keep the motor turning at a constant speed.

In the record mode, a 30 Hz CTL pulse is developed from vertical sync and recorded on the control track.

### Playback

During playback the machine compares CTL and FG timing in a "speed detect" circuit to automatically select the speed the tape was recorded in.

In the playback mode the divided 3.58 MHz reference signal (30 Hz) is passed to the tracking control circuit monostable multivibrator, which allows adjustment when playing tapes that were recorded in other machines (Figure 3-C). The 30 Hz reference is compared with the 30 Hz CTL pulse (Figure 3-D), to provide the phase error signal to the capstan motor drive circuit.

### Cylinder Motor

The cylinder motor (Figure 3-E), like the capstan motor, makes use of a frequency generator (FG) device to produce a 360 Hz signal when it is operating at its correct speed. This signal is divided by 12 (to give 30 Hz) and compared to divided vertical sync during record and to divided 3.58 MHz during playback.

The resulting error signal is sent to the cylinder motor drive circuit and used to maintain the 30 RPS rate required of the motor in both record and playback functions regardless of capstan speed.

### The PG Pulse Indicates The Position Of The Heads And Is Used In Head Switching

A magnet located on the cylinder motor flywheel corresponds to the position of one of the video head tabs. The magnet produces a pulse in a pickup coil or Hall effect device with each revolution and becomes the PG signal source.

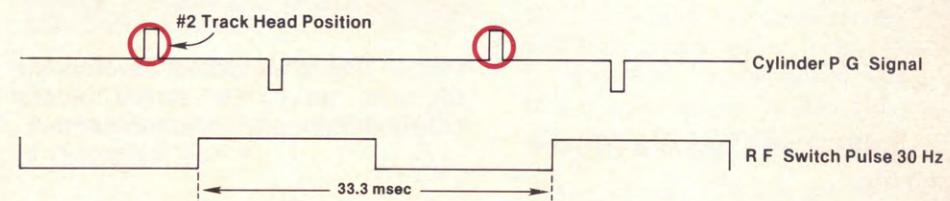
### Developing The Head Switching Pulse

From the PG pulses another waveform (Figure 3-F) is developed, known as the RF switch (or head switching) pulse. During formation of the RF switch pulse, the negative PG pulse is ignored and only the positive portion of the pulse is used. The RF switch pulse switches the video head during playback.

When this 33.3 millisecond (30 Hz) waveform is in its negative half cycle during playback, the track 1 head will be switched on and the track #2 head will be on during the other half cycle. By adjusting the "PG MM" control, the position of the switch point where each head is turned on can be placed at the required six and one half horizontal lines before vertical sync. The RF switch pulse is also used in other areas of the machine for control purposes.

### Controlling The Cylinder In Record And Play

In the record mode, cylinder motor phase control is accomplished by



**Fig. 4: The RF switch pulse (head switching pulse) switches the video heads during playback. The positive going portion of the PG pulse is used to develop the switch pulses.**

# Sencore President Turns Over Reins To Next Generation



Left to right: Randy Koepsell, Herb Bowden, Al Bowden and Doug Bowden.

Herb Bowden, founder of Sencore, Inc., producers of electronic analyzers primarily for the video field, turned over the Presidency to son Alan Bowden and Executive Vice Presidency-Marketing to son Doug Bowden at a recent board meeting. Herb, who will now assume the title of Board Chairman, explained that the transition is being made with great confidence and enthusiasm as he turns over the key administration jobs to the next generation after serving 37 years as President and CEO. Al was formerly Executive Vice President in charge of Internal Operations and Doug was Vice President of Human Resources. Randy Koepsell, former Controller and Treasurer, has been advanced to Vice President-Finance. Herb Bowden explained that Sencore has grown more than 7 times in sales volume and net worth since moving to Sioux Falls from the Chicago area in 1970. More than 70 people have been added to the Sencore workforce this past 12 months, bringing the total to over 325.

comparison of the 30 Hz pulse generator (PG) signal with one half divided vertical sync (30 Hz) which has been separated from the composite sync of the signal being recorded.

In playback the 30 Hz PG signal is again compared with the 30 Hz reference signal obtained from divided 3.58 MHz. The result of these comparisons, in both record and play, is the phase error signal output to the cylinder motor drive circuit for phase correction.

Cylinder phase in some machines is adjusted slightly during forward and reverse search modes to lock the noise bar in the picture in one position. This prevents it from entering the vertical interval and provides a stable picture during search. This is done by adjusting the reference 30 Hz signal to 29.49 in forward search and 30.51 in reverse search.

## Cylinder And Capstan Motor Control

For the cylinder motor, digital counters (Figure 3-G), clocked by divided 3.58 MHz (cylinder speed  $F_{sc}/2$  and cylinder phase by  $F_{sc}/8$ ), develop the error information which

is then used to pulse width modulate a 1750 Hz carrier. Pulse width modulation refers to the ability to control the duty cycle or "on time" of a rectangular waveform. In the case of capstan digital speed error development (Figure 3-H), the master clock is again divided 3.58 MHz (See Figure 5). The divide rate is controlled by the speed select circuit. The digital phase error clock frequency is 447 kHz.

Mode	Speed Error Development	Resulting Error Information
SP	3.58 MHz divided 4 times	895 kHz
LP	3.58 MHz divided 8 times	447 kHz
EP	3.58 MHz divided 12 times	298 kHz

Fig. 5: Digital counters develop the signals used in pulse width modulator circuits for motor control.

The resulting error information is used to pulse-width modulate a 3.5 kHz carrier for speed control. A 44 Hz carrier is used for phase correction.

These pulse-width modulated signals, two from the cylinder circuit and two from the capstan circuit, are routed through low pass filters and become DC levels which are then applied to adder circuits (Figure 3-I). The results become the cylinder and capstan motor servo drive voltages.

## Check The Servo IC Inputs

All of the circuitry (with the exception of the low pass filters), used to perform these functions is usually contained in one Large Scale Integrated Chip. Since so many inputs and outputs are hidden within the body of the IC, the technician must be able to make troubleshooting determinations from the external information available to him. The control signals from each assembly must be checked for proper level at the inputs of this IC.

Since digital counters will continue to operate in the absence of reset pulses, but will provide non-synchronized results, it is very important to confirm the presence of all primary and reference information at the appropriate servo IC inputs. This is best accomplished with a frequency counter and an oscilloscope.

If all necessary primary and reference information is being input to the servo IC and proper adjustment signals are not being produced, the IC itself is defective and must be changed. Mechanical malfunctions in the motors themselves may cause erroneous primary information at the servo IC.

Many times, head switching problems are mistaken for servo problems *when in fact they are the result of distortion of the RF switch pulse (SW30)*. The importance of RF switch pulse distortion cannot be stressed enough. This pulse is fed to several areas in the machine including System Control. It can become distorted by component failures that have nothing to do with Servo problems and can cause erratic head switching and noise bands in the video output.

**Editor's Note:** Do you need more information on VCR servicing? Call your Area Sales Engineer, 1-800-843-3338, and ask about Sencore's Universal VCR Block Diagram and VCR Functional Analyzing Troubleshooting Guide. ■



## The CR70 "BEAM BUILDER": The #1 Money Maker In Your Video Service

by Paul Nies, Application Engineer

takes just a few minutes of your time. Isn't it worth taking a few minutes to save an hour or two of profitable time later? In addition to valuable time savings, the CR70 adds to your profits another way - by saving you from footing the bill for wasted parts.

### No More Profit-Eating Estimates

Has this ever happened to you? You go through a set and find a lot of



**Fig. 1:** Mal Hodgdon watches as Stan, his "Master Tech" restores a CRT. "I've given orders here that every TV that comes in here is to have the tube tested first thing . . ."



**Fig. 2:** Checking the CRT before beginning a repair may save you hours of wasted time, wasted efforts, and wasted profits.

problems, and you call the customer with the estimate. He (though somewhat hesitantly) says "OK, go ahead, it's been a good set." So you order the parts, and finally they come in. You get the set running,

**W**hen was the last time you serviced a television receiver, a projection television system, or a data display or computer monitor that did not have a CRT? That may sound like a rather silly question. Of course, EVERY video system (except for a very few which use LCDs) contains a CRT as the final link between it and the customer. Well, let me ask you another question. "Are you cashing in on the biggest profit-generating opportunity of your service business?"

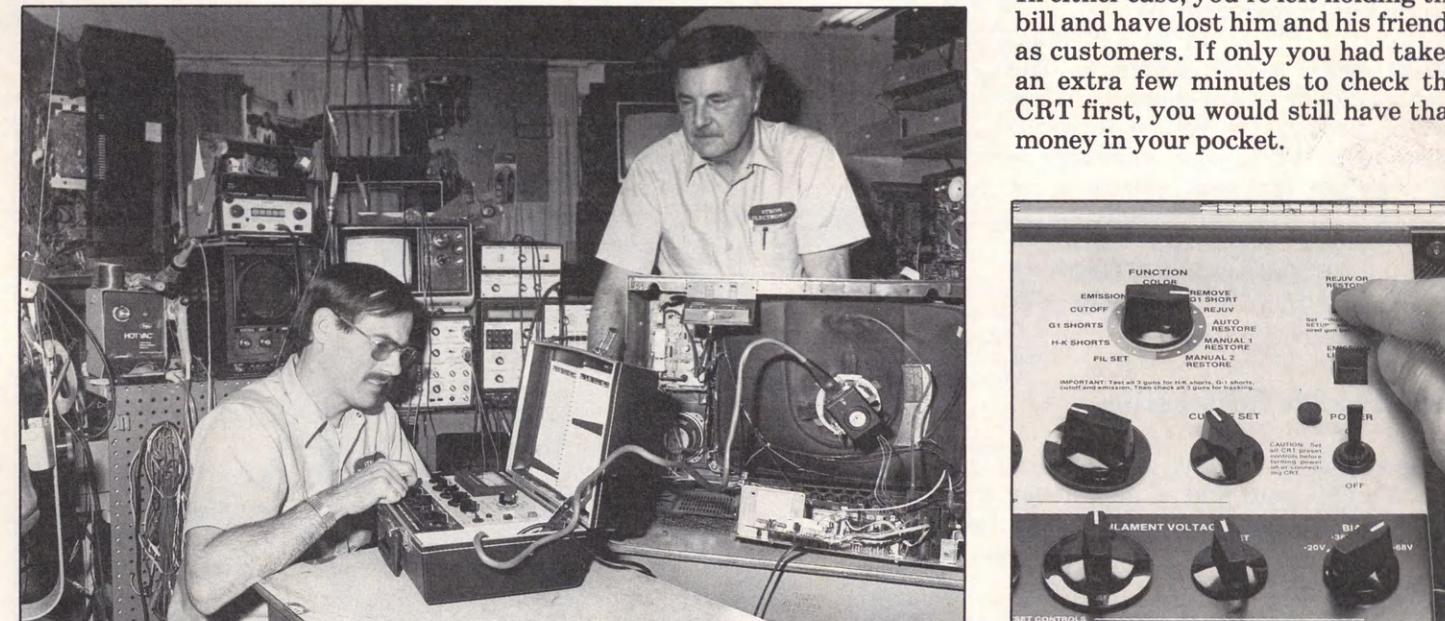
Sure, you may have already expanded your business from "TV only" to Video, or expanded it in other ways. But are you really equipped to effectively service and reap profits from the most vital and critical link in any video system, the CRT? Let's see how the CR70 Universal CRT Analyzer and Restorer can open up new profits for you and your video service business.

### A Universal CRT Analyzer

A CRT tester may easily be one of the most important pieces of test equipment on your service bench. Why? Because knowing if the CRT is good or bad will save you the time and money that no other piece of test equipment can. Mal Hodgdon, CR70 owner and owner of Strom Electronics in Northbridge, Mass., explains why this is so.

### Wasted Time, Wasted Profits

"We've had the CR70 now for going on two years and it has well paid for itself a long time ago . . . The machine has made us money, and [saved] the gray hair for the extra time it would have taken me to set up the Heathkit [CRT tester] and not be able to do a lot of things with a lot of tubes that I can do with the CR70. We take it on just about every service call. We throw it in the van, just about every house call we take it along."



**Fig. 3:** The CR70's progressive restoration is an important money maker for many shops.

Time savings and parts savings are two ways that the CR70 can be your number one money maker. Testing CRTs is only half of the CR70 story though.

### A Universal CRT Restorer

The CR70 "BEAM BUILDER" is more than just a universal CRT tester. It is also the most reliable CRT restorer on the market. The CR70's restoration (we call it progressive restoration) is an important money maker for many shops and companies.

After Strom Electronics tests the condition of a CRT and finds it to be weak, their next step is restoration. For them, restoration is a means of generating extra profits, profits not just from the restoration charge itself, but as future business.

## Restoration As A Business Builder

Mal explains, "We charge \$35 [for restoration], and in a lot of cases it leads to different things. We warranty the restoration for a year with the stipulation that if the restored tube doesn't last a year, either they buy a new tube and we deduct that [restoration] money; they buy a used set and we deduct that [restoration] money; or they buy a new set and we deduct that [restoration] money. So that helps us get a grip on it. Even if it goes out three months later, they call us up and say 'Oh, I'm not getting a good picture', we give them their options and it sort of helps out. They come back to you."

"What happens a lot of times," Stan the Master Technician at Strom Electronics added, "is that you restore the picture tube and then set the color for the customer. Setting up the color would have given them some improvement to start with, but restoring the tube and then setting up the color gives them a dramatic improvement."

Most shop owners agree to the importance of return business. What better way to get return business than to 1) offer your customer a savings on his next purchase or repair, or 2) send him happily on his way with a repair that performs better than it did before it broke. In either case, the CR70 can help your shop increase your profits.

## Progressive Restoration

Restoration can only be a profit builder for you and a happiness builder for your customer if your CRT restorer doesn't damage the CRT. The CR70 "BEAM BUILDER" gives you five levels of restoration, so you can successfully build your profits, rather than watch them go up in a flash.

One East Coast service shop refurbishes nearly 10,000 motel and hotel televisions a year. Of those, nearly 9,000 are restored with the "BEAM BUILDER". The shop owner explained that his other CRT restorer had too much restoration for the newer small necked CRTs with wide deflection angles. His

older CRT tester was simply destroying the tubes. The CR70's five levels of progressive restoration allowed him to successfully restore these tubes. In fact, the shop has purchased two CR70's to keep up with the work!

Restoration current that is too strong can do more harm than good. Instead of only removing the upper "crud" layer on the cathode, excessive restoration overheats the cathode, literally boiling and stripping away the emitting material.

## Restore CRTs With Confidence

Many technicians will use restoration on tubes only if they "have nothing to lose." or as a last resort "when it can't hurt anything." You may remember past experiences with a "black box" restorer which damaged more tubes than it improved, and cost you more in lost profits than it generated. "Restore CRTs with confidence and generate extra profits?" you say, "show me how!"

"Jeff King has confidence in the CR70's progressive restoration. Jeff is a video technician at Producers Color, Southfield, Mich., "the largest video production outfit in the midwest," as Jeff describes it. He is responsible for keeping all the video equipment in top working order - including nearly 200 video monitors containing high definition CRTs which cost \$1000 each to replace. To date, Jeff and the crew have restored about one-half of the CRTs in the company's 200 plus video monitors with the CR70.

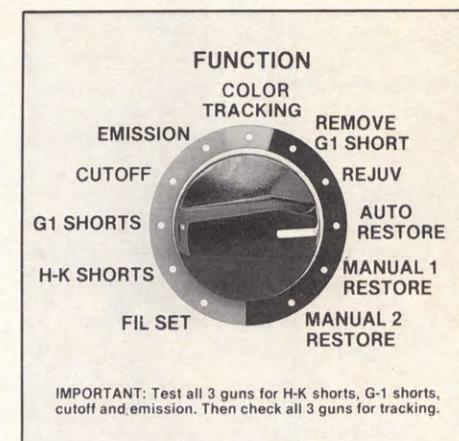
"We make many of the 'Big 3' auto manufacturers' commercials here," Jeff told us, "so what they are looking at is critical . . . Monitor tubes generally cost about \$1000. The first time restorations last about a year or year-and-a-half, up to two years in a broadcast environment for tubes that are used at night," Jeff explained, based on his past experience at a television station.

"Usually the [total] life of a restored tube is three or four years, so roughly that's a savings of \$250 for



**Jeff King of Producers Color successfully restores video monitor tubes which cost about \$1,000 a piece to replace. "Usually the total life of a restored tube is three or four years, so roughly that's a savings of \$250 for each tube."**

each tube. There is no difference [in a restored CRT's picture] at all. We just let it settle down for a day or so before doing the final gray scale setup."



**Fig. 5: The CR70 provides five levels of progressive restoration which allow you to restore CRTs with reliability and confidence.**

Why can you have confidence in the CR70's restoration? Other CRT restorers give you two choices in restoration current - either all or none. The CR70's progressive restoration provides you with five levels of restoring current, and confidence. To make sure you don't over restore and damage the tube, you simply start at the lowest level, auto restore, and move up to the higher levels if the tube does not respond.

Are you cashing in on perhaps the biggest profit-generating opportunity of your service business? You can be. First make sure you know the condition of the CRT before you dive into your next repair. It's too late to find out that it's a lemon AFTER you've done everything else. Lastly, make sure you can confidently restore those weak and shorted CRTs. Offer your customer an alternative to an expensive repair and you'll earn extra profits.

Do you have questions about CRT testing? Or about this article? Call 1-800-843-3338 and ask your Sales Engineer. ■

## Is Technology Passing You By? Perhaps It's Not Too Late! (continued from page 10)

stereo TV generators' output, were set with about 14 percent modulation. We advised them to double check our recommendation as we were going to use 50 percent as standard. We believe that this may be one reason why you are finding stereo TVs that either don't respond to competitive generators or are incorrectly aligned and thus malfunctioning.

The more that you learn about stereo TV, learn how it must be checked through the whole RF and IF and take-off systems (to have any

meaning - much like color TV), the more you realize that you must have an analyzer to make any sense out of a repair job. Further, because the TV stereo is phase-locked to the TV horizontal sync signal, to prevent video interference, the stereo TV generator must generate its own FCC standard sync pulses with the stereo signal phase-locked to it.

The generator must also generate a phase-locked video pattern and color pattern to be sure that there is no interference between these two which will show up in the picture.

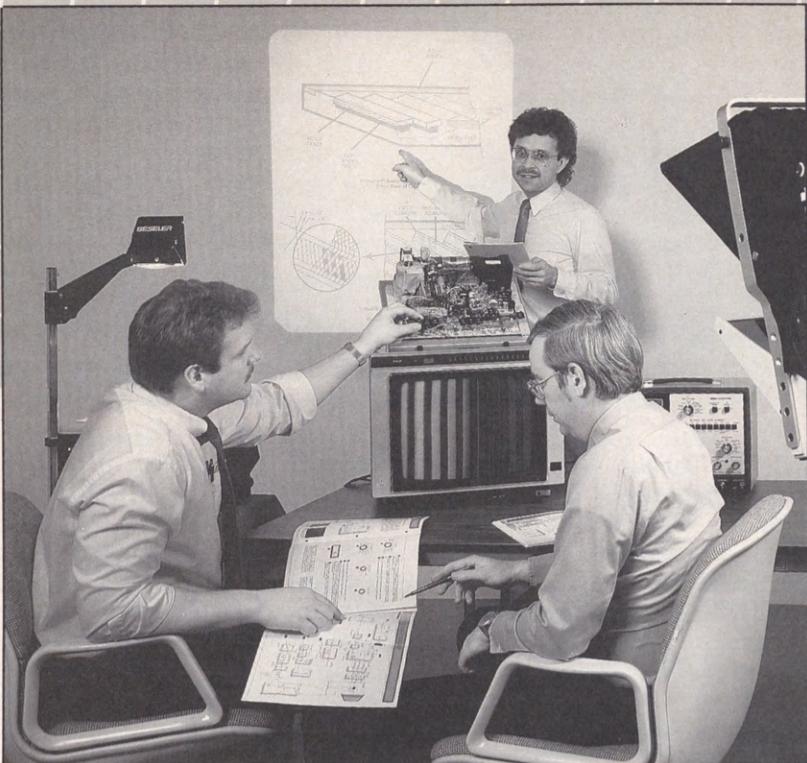
The Sencore Stereo TV Analyzers are the only generators in the market that meet this criteria. The ST65 is designed to phase-lock and work with your VA48 or VA62 Video Analyzer. The ST66 generates its own video and color patterns and also phase-locks as an integral part of your Sencore Video Analyzer.

## Where Will You Be A Year From Now?

Will you have taken advantage of this video explosion and updated?

Will you have updated with the only company that provides you application news, seminars, toll free technical assistance or booklets that help you understand these new systems? Or will you just say OOPS, there went another opportunity that passed me by? That decision is up to you. Want to talk to your sales engineer about it? Just pick up your phone and call WATS Free 1-800-843-3338 and tell the phone operator your area code. She will put you in touch with your sales engineer, your friend at the factory, and it won't cost you a cent. ■

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## Learn How The FS74 CHANNELIZER'S Video Monitor Helps You Find Troubles In CATV Or MATV Distribution Systems

by Greg Carey, Application Engineer, CET

Standard TV tuners also vary in frequency response from one channel to the next, and may mask problems on some channels. Response problems show clearly with the FS74's tuner, which uses a microprocessor to provide channel by channel signal correction.

TV receivers use peaking in the video amplifiers to emphasize the edges of objects in the picture.

Peaking causes the edges of the picture to look very similar to cable ringing. The peaking in a small receiver may cause you to miss ringing caused by a bad cable or an open termination, which shows on a large screen. Only non-peaked video amplifiers, like those used in the Channelizer Sr., let you see subtle ringing on a small, portable CRT.

### Why Isn't The Picture In Color?

Color makes many problems difficult to interpret. There are two main reasons: 1) A color CRT has less detail than a monochrome CRT, and 2) Color masks some video problems. Let's examine these two points in greater detail (Fig. 2).

Why do we say color TV has poor detail compared to the FS74? There are two main causes: chroma bandwidth and phosphor dot/stripe size. First, the NTSC color subcarrier only has a 1 MHz bandwidth. This represents a 500 kHz response since the 1 MHz color band includes both the upper and lower sidebands. By comparison, the luminance signal has 4.2 MHz of video response. A black and white display can show detail (or

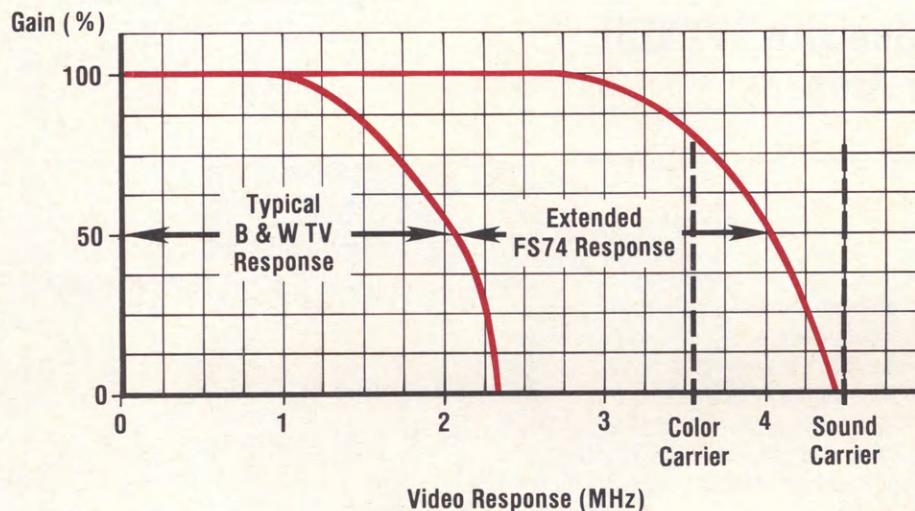


Fig. 1: The restricted frequency response of most B & W TV receivers hides problems which affect large screen receivers. The full 4 MHz response of the FS74 shows the troubles clearly.

interference from the 3.58 MHz color subcarrier. If the video amplifiers do not eliminate the color signals, they cause graininess in the picture.

The FS74's expanded bandwidth allows its CRT to show troubles which normally appear only on large-screen receivers. The small size provides portability, to let you make tests anywhere you need to as you track a problem back to its source.

### Besides Bandwidth, Do Separate TVs Have Other Limitations?

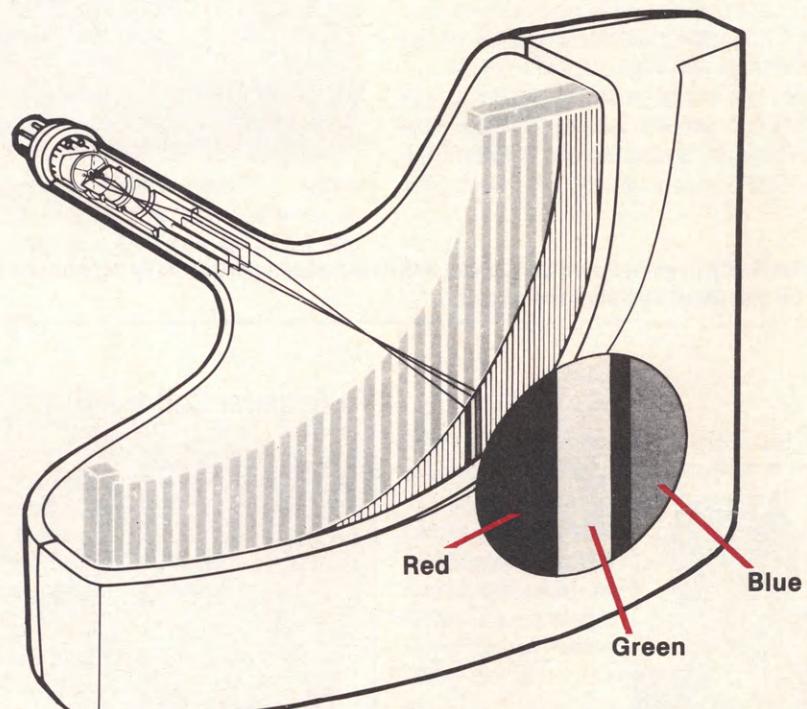
Yes, there are other reasons a standard TV will not tell nearly as much as the FS74's monitor.

Remember, that most interference (such as co-channel signal mixing or ghosting) only affects one channel, or a few channels across the band. And, portable receivers rarely have all-channel, digital tuners. This prevents them from finding interference on many channels used in CATV or MATV systems.

### How Can The FS74 Show Problems I Can't See With A Portable Black And White TV?

The FS74's CRT provides a full 4 MHz of video bandwidth. Most B&W receivers restrict video bandwidth to 1 or 2 MHz. This reduced bandwidth offers advantages in portable receivers, because it masks high frequency noise or snow produced by the tuner on low level signals. The limited bandwidth also saves cost (Fig. 1).

Even the best black and white receivers must roll off the video response at 3 MHz to prevent video



Courtesy of Sony

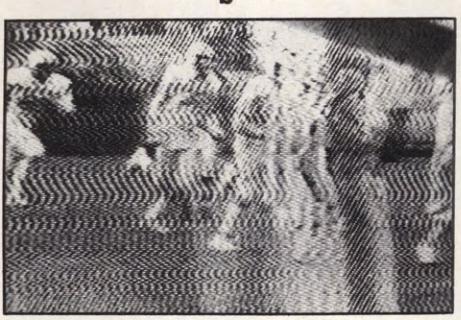
Fig. 2: A color CRT cannot show detail smaller than one set of colored stripes on the face. Small CRTs only have room for about 100 stripes, which is not enough detail to show interference or ghosts.



a



b



c

**Fig. 3:** These are three examples of problems that show up in the FS74 monitor, which are tough to find with a meter or spectrum analyzer: a) Ringing in the picture, b) Ghosts, c) Co-channel interference.

interference, ringing and ghosting) 8 times smaller than a color display.

Secondly, a color CRT cannot display picture defects smaller than the size of one set of three phosphor stripes (small color CRTs use striped color screens). A 19 inch screen has about 300 stripes across the screen, but a 5 inch screen has only about 100 stripes. Thus, the receiver in the home is three times more likely to display problems than a portable color receiver.

Besides the technical limitations, the color itself hides certain problems. The constantly changing colors in a TV program add distractions which make it more difficult to notice a particular type of interference.

The FS74's CRT eliminates these problems. It shows full video bandwidth, showing any type of interference that will show on the highest quality projection model. The continuous (non-striped) phosphor surface of the monochrome CRT displays every detected trouble. And, the monochrome picture eliminates distractions (Fig. 3).

Secondary advantages of using a monochrome display involve cost, size, weight and power consumption. These benefits simply add to the technical advantage of using a monochrome display.

## How Can I Use The FS74 To Find Interference Problems?

The signal supplied to the CRT comes in through the same attenuator as the metering circuits, allowing you to adjust the input signal until the interference becomes visible. You may want to take manual control of the attenuator (which is normally autoranged) to find the one level of attenuation which makes the trouble most visible. When you do this, ignore the meter reading, since you may need to have the input set to a higher or a lower meter scale than when you are making signal measurements. By

to pinpoint external noise is to analyze the picture on the FS74 monitor for clues of the interference (Figure 3).

## How Can I Tell Co-Channel Interference From Adjacent Channel Interference With The FS74 Monitor?

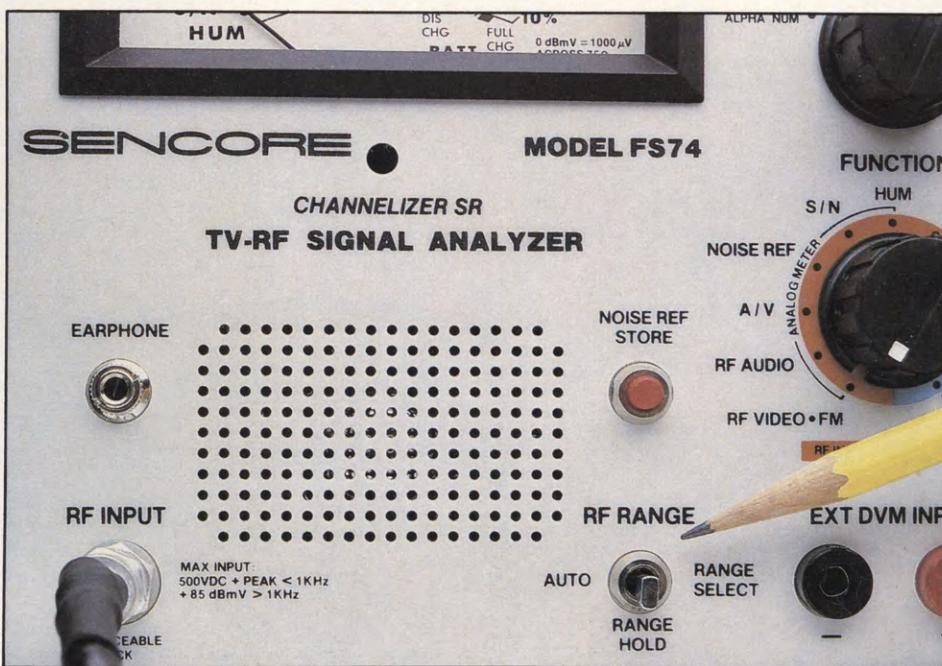
Co-channel interference shows as two superimposed pictures and a beat pattern (Figure 3c). It is caused by an off air television channel beating against a channel on the distribution system. Co-channel interference is often reduced by offsetting the cable channel.

Adjacent channel interference, on the other hand, occurs when the carriers of two television channels located next to each other beat together. This produces superimposed pictures on the FS74 monitor if the upper adjacent channel is interfering, or sound beats in the picture if the lower adjacent channel is interfering.

## Can I Use The FS74 To Test Systems With Suppressed Sync Or Other Security Methods?

These are "scrambled" systems. The FS74's metering circuits will measure the carrier levels of these systems, but the monitor has no provisions to de-scramble the TV signal. Simply, ignore the monitor when testing these channels. If you need to test the scrambled channels for picture quality, you will need to make the test at the output of a converter, which converts the signal to normal video modulation.

Have questions about this article? Give us a call at 1-800-843-3338; ask your Sales Engineer about the new Tech Tips. ■



**Fig. 4:** The exclusive autoranging input attenuator can be manually controlled to let you make the interference or ghost easier to see in the FS74 monitor.

controlling the input level, the FS74 monitor gives you more troubleshooting ability than the best TV receiver you can find (Fig. 4).

The FS74's monitor also helps you identify the source of noise and interference in any cable system, such as noise generated within the system, external noise, co-channel interference, and adjacent channel interference (Fig. 5).

Noise generated within the system appears as snow distributed throughout the FS74 monitor picture. This noise may originate at the headend antenna where it is picked up along with the desired signal, or the snow may be added to the system by a defective amplifier.

External noise includes mobile radios, lightning, ignition noise, and interference from electrical motors. External noise enters the system through breaks in the coax shield, loose connectors, or amplifier housings. This type of noise may come and go as a radio transmitter is keyed, motors start, or vehicles drive past the break. The best way

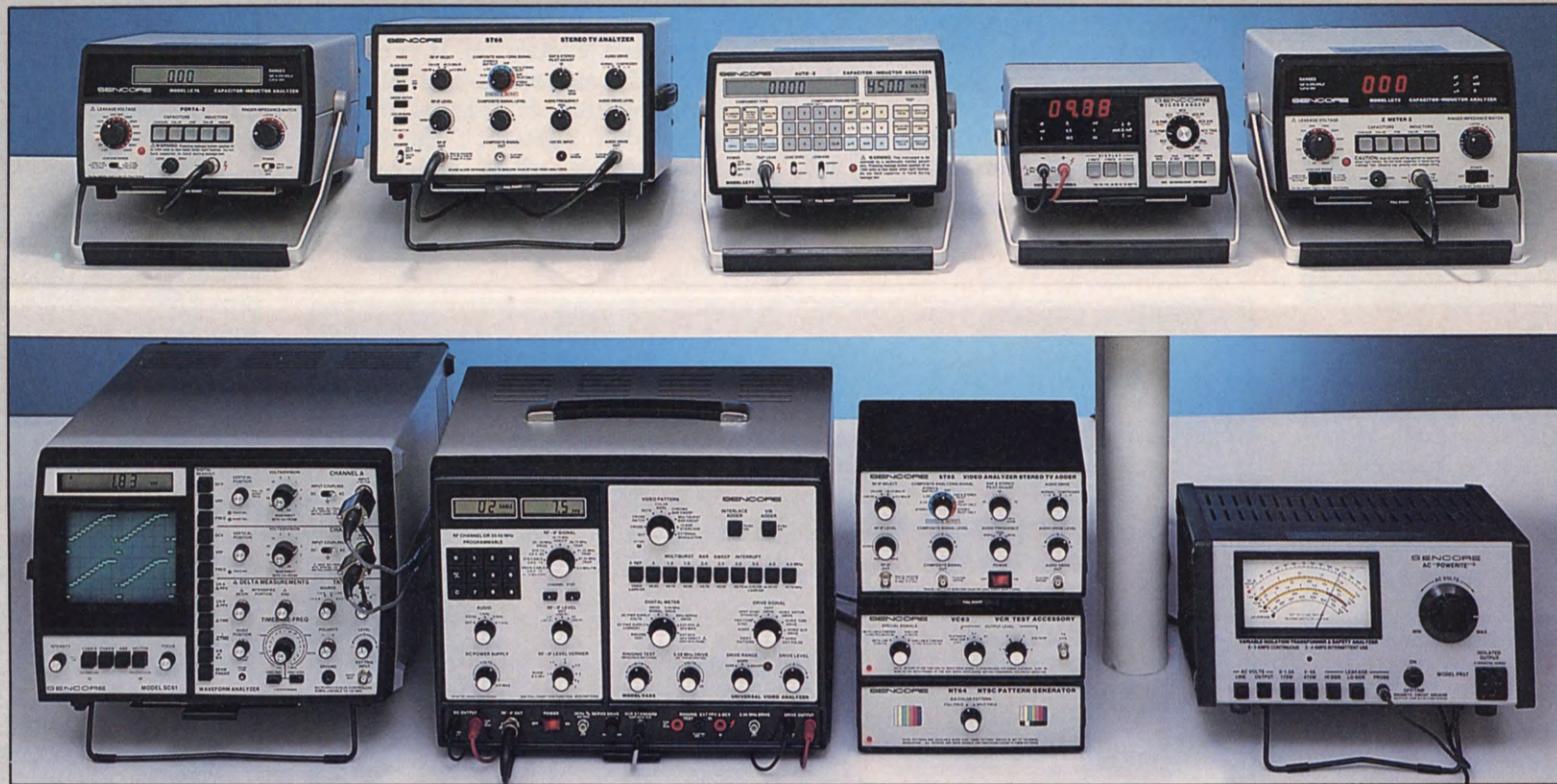


**Fig. 5:** Since the FS74 monitor is powered from batteries, you can check for interference at any point in the distribution system.

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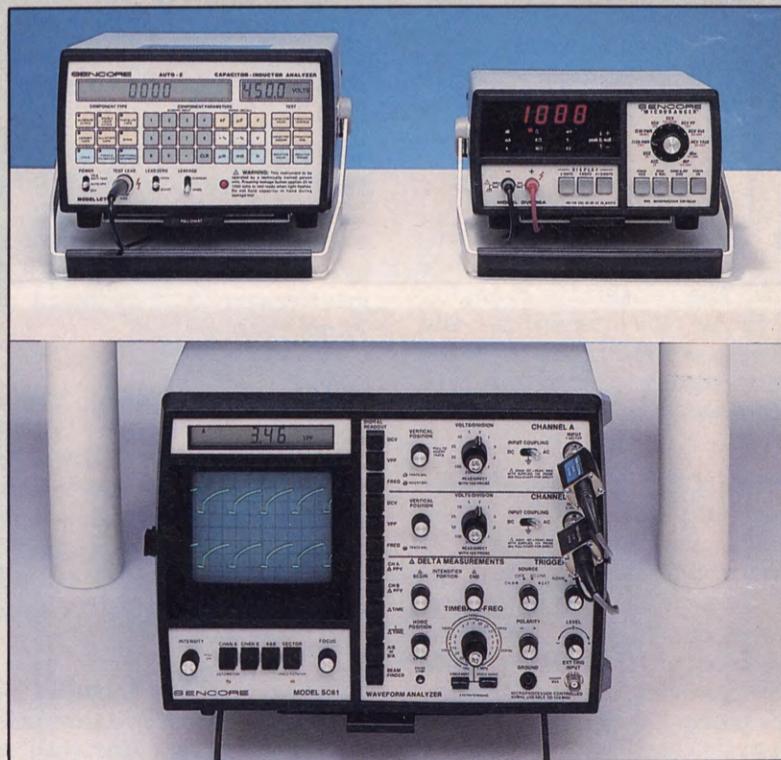
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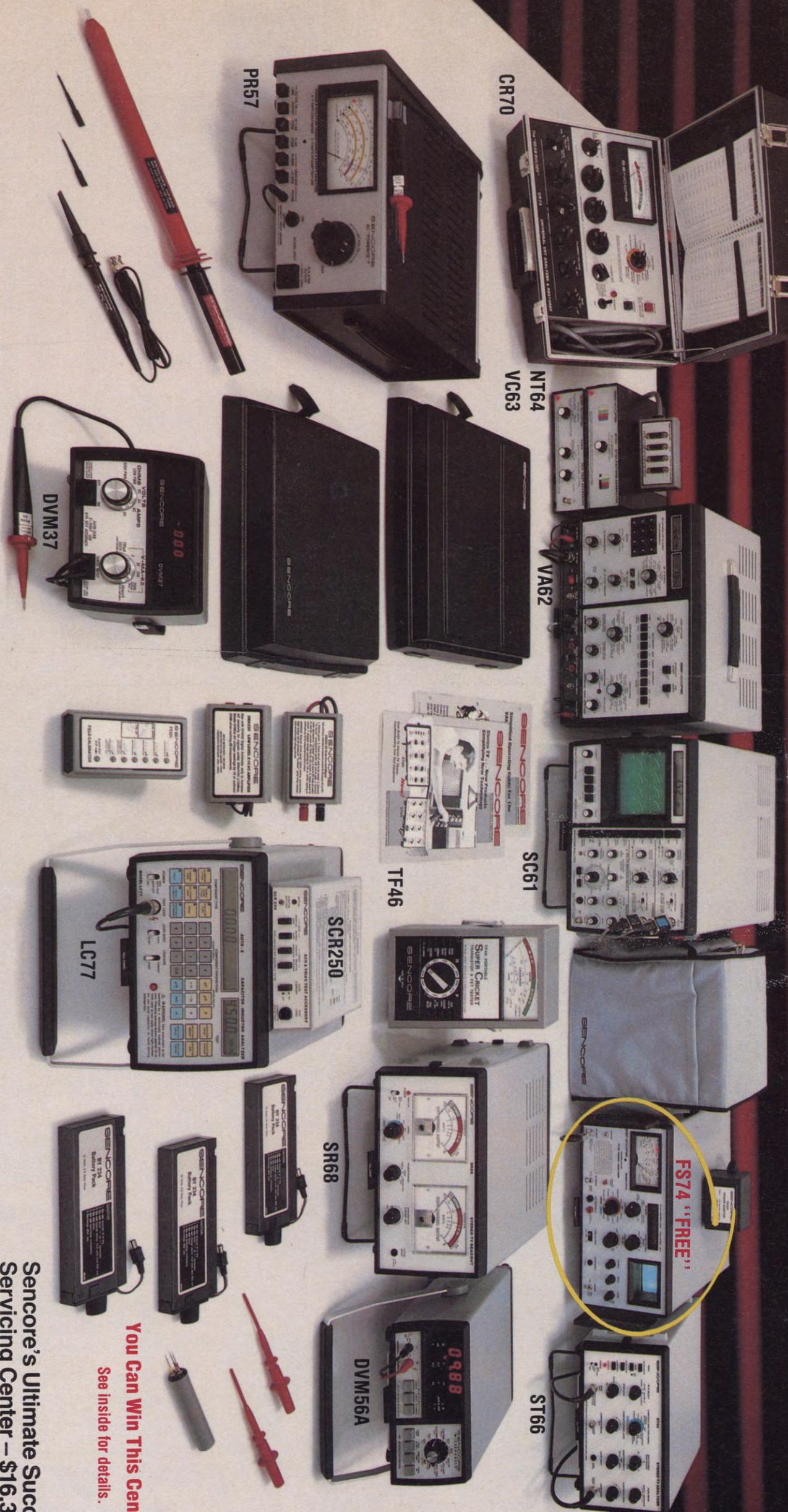
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